

TECHNICAL MEMORANDUM

MAY 6, 2016

**Draft Final Identification and Screening of Technologies Technical
Memorandum Phase 1 Feasibility Study
Operable Unit 3 Study Area, Libby Asbestos Superfund Site, Libby,
Montana**

1.0 INTRODUCTION

This section will be provided in the Draft Phase 1 OU3 Study Area Feasibility Study. See transmittal letter for additional details.

2.0 SITE CHARACTERISTICS

This section will be provided in the Draft Phase 1 OU3 Study Area Feasibility Study. See transmittal letter for additional details.

3.0 REMEDIAL ACTION OBJECTIVES

Section 300.430(e) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires the remedial alternative development process be initiated by developing preliminary remedial action objectives (PRAOs), identifying general response actions (GRAs) that address these PRAOs, and performing an initial screening of applicable remedial technologies within the categories of GRAs. The goal of the remedy selection process is to select remedies that are protective of human health and the environment, maintain protection over time, and minimize untreated waste.

This section presents the current and reasonably anticipated future land uses, the applicable or relevant and appropriate requirements (ARARs) identification process, and the PRAOs for the OU3 Phase 1 Area (Phase 1 Area). A discussion regarding the development of performance criteria for the Phase 1 Area in lieu of preliminary remediation goals also is presented. The final ARARs, remedial action objectives (RAOs), and performance criteria will be developed from evaluations presented within this FS and set forth in the Record of Decision (ROD).

3.1 CURRENT AND REASONABLY ANTICIPATED FUTURE LAND USES

The current and reasonably anticipated future land uses for the Phase 1 Area were considered during the development of PRAOs and performance criteria to identify remedial alternatives that would be protective of human receptors. The final condition of the Phase 1 Area after remedial action must be considered in evaluating future land uses or activities and the related protection to human health that is provided.

Information pertaining to the current and reasonably anticipated future land uses within the Phase 1 Area is discussed in detail in **Section 1**. For purposes of the FS, current and future land uses within the Phase 1 Area are evaluated within the context of the two land use categories discussed below:

- Private, Non-Residential Land Use - Areas that are privately owned, have no structures or structures that are non-residential, and are used at least in part for non-residential purposes.
- Forest Management and Recreation - Areas that may be used for both public recreational and commercial or non-commercial forest products activities. These are areas that afford multiple recreational opportunities to the public. Recreational opportunities may include, but are not limited to hiking, shed-antler hunting, hunting, camping (campfire wood gathering and campfire construction/burning), riding all-terrain vehicles (ATVs) in the forested areas, and fishing and boating along creeks and rivers.

The following assumptions are made in this FS for current and reasonably anticipated land uses:

- The expectation and assumption in this FS report is that although the remedial measures established to protect human health and the environment may not allow unrestricted uses, they would be protective for anticipated future uses, assuming the remedial measures are kept intact.
- No residential exposure scenarios were developed as a part of the Final Human Health Risk Assessment for Non-Asbestos Contaminants (CDM Smith, 2013a) or the Final Site-wide Human Health Risk Assessment (for Libby Amphibole Asbestos (LAA)) (EPA, 2015b) for the Phase 1 Area because any properties geographically within the OU3 Study Area that are currently residential will be evaluated as part of OU4 (CDM Smith, 2013a). Because various land uses may apply to an individual private parcel within the Phase 1 Area, LAA impacts to residential land will be addressed as part of either the OU3 Study Area or OU4 as follows: To the extent that the area within the Phase 1 boundary included in the FS includes private property, the portion of the property that is used frequently by residents (e.g. homes, yards, other frequently used areas) will be included in OU4. However, if these properties contain forested/meadow/pasture areas where the use of the property is limited, these forested/meadow/pasture areas will be included in the OU3 Study Area. Areas where the entire private property parcel is forested and undeveloped will be considered part of the OU3 Study Area. Based on currently available information, future residential development is not reasonably anticipated in other areas of the OU3 Study Area (CDM Smith, 2013a).
- Future land uses or activities that would compromise the protectiveness of measures implemented under a remedial action would be considered unacceptable.

3.1.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Identification and evaluation of ARARs are integral components of the FS process to determine whether remedial alternatives will meet the Federal and State ARARs. The following information in this subsection was developed from the United States Environmental Protection Agency's (EPA's) *Introduction to Applicable or Relevant and Appropriate Requirements* (EPA, 1998), in which they give an overview of why ARARs must be identified and evaluated as part of the CERCLA process.

CERCLA and the NCP establish a standardized process through which the EPA must respond to spills and clean up the nation's most dangerous hazardous waste sites. The CERCLA response process, while it sets acceptable risk-based goals for cleanups, does not impose specific restrictions on the various activities (such as treatment, storage and disposal of wastes, construction and use of remediation equipment, and release of contaminants into air, soil, and water) that may occur during a

response. The EPA instead relies on other eligible federal and state environmental laws and regulations to govern response activities through the ARARs selection process.

A site-specific risk assessment is the foundation on which the selection of a CERCLA remedy is based. ARARs fill in the substantive gaps in CERCLA's risk-based response framework, ensuring compliance with Federal and State ARARs. ARARs, used in conjunction with risk-based goals, govern the CERCLA response activities and establish performance criteria.

3.1.2 ARAR IDENTIFICATION PROCESS

ARARs are designated as either "applicable" or "relevant and appropriate," according to the EPA guidance, and may stem either from federal or state law. Determining which laws and regulations will affect a CERCLA response is somewhat different than determining the effect of laws and regulations on activities that take place outside the boundaries of a site remediated under CERCLA. For onsite activities, CERCLA requires compliance with both applicable requirements (i.e., those that would apply to a given circumstance at any site or facility) and those that the EPA deems to be relevant and appropriate (even though they do not apply directly), based on the unique conditions at a site.

ARARs must be identified on a site-specific basis and involve a two-part analysis. A determination must first be made on whether a given requirement is applicable. If it is not applicable, then a second determination must be made on whether it is both relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (EPA, 1988). Compliance with ARARs is a threshold criterion that any selected remedy must meet unless a legal waiver, as provided by CERCLA Section 121(d)(4), is invoked (discussed in **Section 3.1.4**).

3.1.2.1 Applicable Requirements

Section 300.5 of the NCP (40 CFR § 300.5) defines "applicable requirements" as cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental laws that specifically address a hazardous substance, pollutant, contaminant, removal action, location, or other circumstances at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

3.1.2.2 Relevant and Appropriate Requirements

Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws. Relevant and appropriate requirements are not directly "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site but address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

3.1.2.3 Consideration of State Requirements as ARARs

State requirements are potential ARARs for CERCLA response actions if they meet the following eligibility criteria:

- State law or regulation
- Environmental or facility siting law or regulation
- Promulgated (of general applicability and legally enforceable)
- Substantive (not procedural or administrative)
- More stringent than federal requirements
- Identified in a timely manner

- Consistently applied (EPA, 1989)

Many state requirements listed as ARARs are promulgated with identical or nearly identical requirements to federal law pursuant to delegated environmental programs administered by federal agencies and the state. The preamble to the NCP provides that such a situation results in citation to the state provision and treatment of the provision as a federal requirement.

3.1.2.4 Information to be Considered (TBC)

In addition to ARARs, the NCP states that where ARARs do not exist, agency advisories, criteria, or guidance may be useful “in helping to determine what is protective at a site or how to carry out certain actions or requirements” (55 Federal Register 8666, 8745 (Mar. 8, 1990)). These sources of information are referred to as information to be considered (TBCs).

The NCP preamble states, however, that provisions in the TBC category “should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs.” Although not enforceable requirements, these documents are important sources of information that the EPA and the state may consider during selection of the remedy, especially regarding the evaluation of public health and environmental risks, or which will be referred to, as appropriate, in selecting and developing cleanup actions (40 CFR § 300.400(g)(3), 40 CFR § 300.415(l)).

3.1.2.5 Other Regulatory Requirements Not Considered ARARs

There are other laws and regulations that do not constitute ARARs because they are not specifically related to environmental cleanup or facility siting. One example would be the U.S. Department of Transportation (DOT) regulations for transport of hazardous and nonhazardous materials or wastes; another would be Occupational Safety and Health Administration (OSHA) general construction safety regulations.

3.1.3 CATEGORIES OF ARARS

Environmental laws and regulations generally fit into three categories:

- Those that pertain to the management of certain chemicals;
- Those that restrict activities at a given location; and
- Those that control specific actions.

Thus, there are three primary types of ARARs: chemical-, location-, and action-specific. An ARAR can be one or a combination of all three types of ARARs.

Chemical-specific requirements address chemical or physical characteristics of compounds or substances on sites. These values establish acceptable amounts or concentrations of contaminants that may be found in, or discharged to, the ambient environment.

Location-specific requirements are restrictions placed on the concentrations of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location-specific ARARs relate to the geographical or physical positions of sites rather than the nature of contaminants at sites.

Action-specific requirements are usually technology-based or activity-based requirements, or limitations on actions taken with respect to hazardous substances, pollutants, or contaminants. A given cleanup activity will trigger an action-specific requirement. Such requirements do not themselves determine the cleanup alternative but define how chosen cleanup methods should be performed.

3.1.4 WAIVERS OF SPECIFIC ARARS

CERCLA Section 121(d)(4) authorizes that any ARAR may be waived per one of the following six conditions if the protection of human health and the environment is ensured:

- It is part of a total remedial action that will attain such level or standard of control when completed (i.e., interim action waiver).
- Compliance with the ARAR at a given site will result in greater risk to human health and the environment than alternative options that do not comply with the ARAR.
- Compliance with such a requirement is technically impracticable from an engineering perspective.
- The remedial action will attain a standard or performance equivalent to that required by the ARARs through use of another method or approach.
- The ARAR in question is a state standard and the state has not consistently applied (or demonstrated the intention to consistently apply) the ARAR in similar circumstances at other sites.
- In meeting the ARAR, the selected remedial action will not ensure a balance between the need for protection of public health and welfare and the environment at the site and the availability of Superfund monies to respond to other facilities. This waiver only applies to response actions conducted pursuant to Section 42 United States Code (U.S.C.) §9604.

3.1.5 CERCLA PERMIT EXEMPTION

CERCLA Section 121(e)(1), 42 U.S.C. § 9621(e)(1), states, “No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with this section.” The onsite activities must, however, comply with substantive permit requirements. The term “onsite” is defined in the NCP as “the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action” (40 CFR § 300.5).

While no permits will be obtained for any response actions conducted onsite, the EPA will evaluate the substantive requirements that would otherwise be included in any such permit and determine which substantive provisions must be complied with.

Offsite CERCLA actions would not only require compliance with applicable requirements, but compliance with both substantive and administrative components of the applicable regulations as well.

3.1.6 VARIANCE PROCESSES

The State of Montana has promulgated a variance process within laws and regulations pertaining to floodplain management and solid waste management that may be ARARs for the Site. The specific ARARs for floodplain and solid waste management containing a variance process will be described in an appendix to the Draft FS Report. Administrative requirements, including permit requirements, indicated within those ARARs would not need to be met during a CERCLA response action due to the reasons discussed within **Section 3.1.5**. However, there are some substantive requirements within those specific ARARs that may be difficult or impossible to achieve given the locations of the media and/or the actions that will be contemplated.

The variance process established within these ARARs would potentially allow the EPA and Montana Department of Environmental Quality (MDEQ) to address the substantive requirements posing an implementation issue for a response action without the need to invoke a CERCLA ARAR waiver as discussed in **Section 3.1.4** as long as the variance still allows the response action to be protective. There are specific criteria indicated in these ARARs that would typically need to be met to allow a variance to be granted by the State of Montana during a permitting process, if applicable. Although the

EPA would not need to obtain a permit or be granted a variance, all applicable criteria for the variance would need to be met or shown that if not met, would still result in protectiveness.

The specific implementation issues that would indicate a potential need for a variance are dependent on the list of tentatively identified ARARs, the response actions contemplated, and the location-specific conditions that pose an implementation issue. Thus, the potential need for a variance will be identified as part of the analysis of alternatives within this FS. However, the specific issues and criteria needed to establish that the substantive requirements of the variance are met will be addressed as part of the ROD after a remedy is selected and during implementation during remedial design (RD) and remedial action (RA).

3.1.7 IDENTIFICATION OF POTENTIAL ARARS FOR REMEDIAL ALTERNATIVES

In accordance with the EPA RI/FS guidance (EPA 1988), preliminary ARARs are identified throughout the iterative RI/FS process. During the FS, preliminary or tentatively identified ARARs are used to support evaluation of remedial alternatives (i.e., compliance with ARARs is a threshold criterion that any selected remedy must meet unless a legal waiver is invoked [discussed in **Section 3.1.4**]). The preliminary ARARs for the OU3 Study Area are listed in Attachment A. The final ARARs will be determined in the ROD after a remedy is selected.

3.2 PRELIMINARY REMEDIAL ACTION OBJECTIVES

PRAOs are media-specific and source-specific goals to be achieved through completion of a remedy that is protective of human health and the environment. These objectives are typically expressed in terms of the contaminant, the concentration of the contaminant, and the exposure routes and receptors.

PRAOs are typically developed by evaluating several sources of information, including results of the risk assessments and tentatively identified ARARs. These data are the basis for determining whether protection of human health and the environment is achieved for a particular remedial alternative. As described in **Section 2**, the general conclusions that can be inferred from the human health risk assessments (HHRA) (EPA, 2015b; CDM Smith, 2013a) as part of a risk management decision by the EPA are that human health risks may exist above acceptable levels for human exposure to LAA and may warrant remedial action. The general conclusions that can be inferred from the baseline ecological risk assessments (BERA) (EPA, 2014a; CDM Smith, 2013b) as part of a risk management decision by the EPA are that ecological risks from exposure to LAA and non-LAA constituents are acceptable and do not warrant remedial action.

Based on the HHRA and BERA conclusions, the development of media-specific PRAOs is focused primarily on protection of human health from the inhalation of LAA. The proposed media that could potentially pose human health risks within the Phase 1 Area include duff, forest soil, forest fire ash, and bark. Other PRAOs are related to minimizing migration and compliance with ARARs in surface water and groundwater.

The PRAOs are as follows:

- Minimize exposures from the inhalation of LAA during disturbances of soil contaminated with LAA such that the resulting exposures do not result in cumulative cancer risks that are above EPA's acceptable risk range of 10^{-6} to 10^{-4} or cumulative non-cancer hazard indices that are above 1.
- Minimize exposures from the inhalation of LAA during disturbances of bark contaminated with LAA such that the resulting exposures do not result in cumulative cancer risks that are above EPA's acceptable risk range of 10^{-6} to 10^{-4} or cumulative non-cancer hazard indices that are above 1.

- Minimize exposures from the inhalation of LAA during disturbances of duff contaminated with LAA such that the resulting exposures do not result in cumulative cancer risks that are above EPA's acceptable risk range of 10^{-6} to 10^{-4} or cumulative non-cancer hazard indices that are above 1.
- Minimize exposures from the inhalation of LAA during disturbances of ash contaminated with LAA such that the resulting exposures do not result in cumulative cancer risks that are above EPA's acceptable risk range of 10^{-6} to 10^{-4} or cumulative non-cancer hazard indices that are above 1.
- Minimize the migration of LAA contamination from source material locations by natural and/or man-influenced transport mechanisms to other locations or media.
- Minimize the migration of LAA contamination from source media to surface water and/or groundwater that would result in exceedances of ARARs for those media.

3.3 DEVELOPMENT OF REMEDIATION GOALS

This section will be developed from the Draft Risk Management Strategy. See transmittal letter for additional details.

4.0 IDENTIFICATION AND SCREENING OF GENERAL RESPONSE ACTIONS, REMEDIAL TECHNOLOGIES, AND PROCESS OPTIONS

4.1 OVERVIEW

This section identifies GRAs, remedial technologies, and process options that may be potentially useful to address the PRAOs identified in **Section 3** for the media of interest. The media are of interest if they contain levels of LAA considered to be an unacceptable risk to human health and are present as a result of a release from mining activities, and are herein referred to as "LAA-impacted media." GRAs identify common categories of response actions that satisfy the PRAOs, such as treatment, containment, disposal, and institutional controls. Remedial technologies and process options that fall under the identified GRAs provide further detail on the specific type of response.

In addition, this section presents the screening of GRAs, remedial technologies, and process options in accordance with the NCP to retain representative technologies and process options that will be assembled into remedial alternatives.

The identification and screening process consists of the following general steps:

- Identify the media that pose risks to human health and the environment and group these into a category or categories of LAA-impacted media for FS evaluation.
- Develop GRAs for the LAA-impacted media that will satisfy the PRAOs identified in **Section 3**.
- Compile remedial technologies and process options for each GRA that are potentially viable for remediation of each LAA-impacted media.
- Screen the remedial technologies and process options with respect to technical implementability for the LAA-impacted media at the site. Technologies and process options that are not technically implementable relative to the LAA-impacted media are eliminated from further consideration in this FS.

- Evaluate and screen the retained remedial technologies and process options with respect to effectiveness, ease of implementability, and relative cost. Technologies and process options that have low effectiveness, low implementability, and/or high cost to address the LAA-impacted media are eliminated from further consideration in this FS.

The remainder of this section describes the LAA-impacted media and evaluates GRAs, technologies, and process options that are potentially viable for addressing them to meet the PRAOs and ARARs discussed in **Section 3**.

4.2 CONSTITUENT AND MEDIA OF INTEREST FOR FS

The constituent of interest, based on the risk assessments (EPA, 2015b, EPA, 2014, CDM Smith, 2013a, and CDM Smith, 2013b), is LAA. The environmental media of interest included as part of this FS for the Phase 1 Area are duff, forest soil, forest fire ash, and bark.

The definitions of these media are provided below.

- Duff: Partially- to fully-decomposed bark, twigs, needles, leaves, grasses, and other vegetation and the layer of litter that occurs on top of the mineral soil in forested areas.
- Soil (Forest): The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. Soil excludes materials defined as mine waste, bark, duff, or ash.
- Ash (Forest Fire): The solid residue left when combustible material is thoroughly burned during a forest fire.
- Bark: The tough outer covering of the woody stems and roots of trees, shrubs, and other woody plants outside the vascular cambium.

4.3 GENERAL RESPONSE ACTIONS

GRAs include broad remedial categories, such as containment, removal, disposal, and treatment of the LAA-impacted media. Site-specific GRAs are first developed to satisfy the PRAOs and/or tentatively identified ARARs and then evaluated as part of the identification and screening of remedial technologies and process options for the LAA-impacted media.

The GRAs considered for remediation of different media types are as shown in **Exhibit 4-1**:

Exhibit 4-1. General Response Actions by Media Type

Media Type	GRA						
	No Action	Monitoring	Institutional Controls	Engineering Controls	Containment	Removal, Transport, Disposal	Treatment
Duff	√	√	√	√	√	√	√
Forest Soil	√	√	√	√	√	√	√
Forest Fire Ash	√		√	√	√	√	√
Bark	√		√	√		√	√

No action leaves media in their existing condition with no control or cleanup planned. In accordance with the NCP, this GRA must be retained and considered as a standalone remedial alternative to provide a baseline against which other options can be compared. Additionally, the Risk Management Strategy may identify areas where unacceptable risks were not identified, but remedial actions may be considered as a conservative measure. In these areas, a No Action alternative may be appropriate.

Monitoring involves physical and/or chemical measures applied to the site to determine the rates of natural recovery and/or if there is contaminant migration. Monitoring is not intended to substitute any engineering aspect of a selected remedy and does not physically address the LAA-impacted media.

Institutional controls involve administrative and/or legal restrictions intended to control or prevent present and future use/disturbance of LAA-impacted media. Institutional controls also include informational measures to inform and warn of dangers associated with these LAA-impacted media. These controls are not intended to substitute for engineering aspects of a selected remedy and do not physically address the LAA-impacted media.

Engineering controls involve management of present and future use and access to select areas with LAA-impacted media to reduce exposure resulting from certain human activities. These controls are not intended to substitute for engineering aspects of a selected remedy and do not physically address the LAA-impacted media.

Containment involves physical measures applied to LAA-impacted media materials to control the release of contaminants, provide migration control, and/or prevent direct contact or exposure to the LAA-impacted media.

Removal, transport, disposal involves a complete or partial removal of LAA-impacted media followed by transportation and disposal within or outside of the OU3 Study Area.

Treatment involves biological, chemical, thermal, and/or physical measures applied to the LAA-impacted media that reduce toxicity, mobility, and/or volume of the LAA-impacted media present.

4.4 IDENTIFICATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

In this step of the FS process, remedial technology types and process options that are capable of addressing each of the LAA-impacted media are identified and organized under each GRA listed in **Section 4.3**. This section provides potentially viable remedial technologies and process options for the LAA-impacted media.

The primary source of information used to identify remedial technologies and process options is the *Federal Remediation Technologies Roundtable (FRTR) Remediation Technologies Screening Matrix and Reference Guide, Version 4.0* (EPA, 2007). Other sources of information used for identification of remedial technologies and process options include the FS completed for OUs 4, 5, 6, 7, and 8 (CDM Smith, 2015), relevant EPA guidance, published literature and vendor information (see **Section 5** References), stakeholder input, and engineering judgment based on experience with other remediation projects.

Potentially viable remedial technologies and associated process options identified for remediation of each of the LAA-impacted media are presented in **Tables 4-1a** through **4-1d**.

4.5 SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR TECHNICAL IMPLEMENTABILITY

The remedial technologies and process options presented in **Tables 4-1a** through **4-1d** were first evaluated and screened based on technical implementability. A wide range of potential remedial technologies and process options were reviewed in this step to identify suitable technologies for addressing each LAA-impacted media. The sources of information discussed in **Section 4.4** also were used to perform screening.

A given technology or process option was eliminated from further consideration on the basis of technical implementability if site conditions or site characterization data indicated the technology or process option was incompatible with the contaminant or could not be implemented effectively because of physical limitations or constraints at the Phase 1 Area.

Due to the potential variation in the areal extent and terrain where a process option may be implemented, coupled with the diversity of media types within the Phase 1 Area, technical implementability screening and elimination were performed by evaluating use of the process options on both a large-scale, holistic basis, and a small-scale, potentially high-risk-area basis (e.g., targeted hot spot removal). As such, some of the retained process options were only technically implementable on a small scale for a specific location where potential risks to human exposure are the highest.

The process options eliminated from further consideration in this FS (with the rationale for elimination) are indicated on **Tables 4-1a** through **4-1d** using gray shading. Retained technologies and process options were then carried forward to the second step of the evaluation process as discussed in **Section 4.6**. The screening for technical implementability has resulted in the following general conclusions:

- Remedial technologies/process options that should be eliminated and have no further consideration include those that are unable to remediate the LAA-impacted media due to site conditions or the lack of compatibility with the LAA-impacted media.
- Remedial technologies/process options that have substantial potential and applicability as a stand-alone remedy for the LAA-impacted media are generally retained for further evaluation.
- Remedial technologies/process options that could provide remedial benefits in combination with other remedial technologies but would likely only be applicable for specific site elements, limited areas, and/or particular conditions are generally retained for further evaluation.

4.6 EVALUATION OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR EFFECTIVENESS, IMPLEMENTABILITY, AND RELATIVE COST

Each technically implementable remedial technology and process option retained from the preliminary screening process presented in **Section 4.5** was further evaluated in the second step of the screening process to evaluate whether it should be eliminated from further consideration in the FS or retained for assembly into remedial alternatives.

4.6.1 EVALUATION CRITERIA

Retained remedial technologies or process options for each of the LAA-impacted media were qualitatively evaluated for effectiveness, implementability, and relative cost. The criteria used, as defined in this step of the FS process, are as follows:

Effectiveness. The evaluation of the effectiveness of a remedial technology or process option focuses on:

- Potential effectiveness in handling the estimated quantities of LAA-impacted media and meeting the goals and objectives identified in the PRAOs
- Potential impacts to human health and the environment during construction and implementation
- How proven the remedial technology or process option is with respect to the contaminants and conditions at the site.

Additionally, the environmental impact criterion was expanded to consider the short and long term ecological and environmental impacts of implementing a remedial technology given the Phase 1 Area is a forested environment containing threatened, endangered, and candidate species. The effectiveness analysis is evaluated based on engineering judgment and is ranked relative to other process options across the various technology types.

Implementability. Technically implementable technologies and process options retained from the screening step described in **Section 4.5** are evaluated with respect to both the technical and administrative feasibility of implementing a remedial technology or process option. Technical implementability was used as an initial screening step in **Section 4.5** to eliminate remedial technologies and process options that were clearly ineffective or unworkable at the Phase 1 Area. This subsequent screening criterion places greater emphasis on the institutional (i.e., administrative and logistical) aspects of implementability. This criterion focuses on:

- Ability to obtain permits for offsite actions
- Administrative and institutional feasibility
- Availability and capacity of treatment, storage, materials, and disposal services
- Availability of necessary equipment and skilled workers

The implementability analysis is evaluated based on engineering judgment and is ranked relative to other process options across the various technology types.

Relative Cost. Cost plays a limited role in the screening of remedial technologies and process options at this stage of the process. Relative capital and operation and maintenance (O&M) costs are used rather than detailed estimates. The cost analysis is evaluated based on engineering judgment and is ranked relative to other process options. Since remedial alternatives and associated remedial quantities are not defined during this technology and process option screening, relative cost is presented qualitatively as a range rather than quantitatively.

4.6.2 SCREENING EVALUATION

Each of the remedial technologies and process options retained from the first screening step for all of the LAA-impacted media were evaluated against the three criteria identified in **Section 4.6.1** to determine whether they should be eliminated from further consideration in the FS or retained for assembly into remedial alternatives. The results of this second screening step are presented on **Tables 4-2a through 4-2d**.

Exhibit 4-2 presents the qualitative rating system used in conjunction with the stated rationale to justify the ratings with respect to each criterion.

Exhibit 4-2. Qualitative Rating System for Screening of Remedial Technologies and Process Options

Effectiveness and Implementability		Relative Cost	
0	None	0	None
1	Low	\$	Low
2	Low to moderate	\$\$	Low to moderate
3	Moderate	\$\$\$	Moderate
4	Moderate to high	\$\$\$\$	Moderate to high
5	High	\$\$\$\$\$	High

This evaluation and screening process is inherently qualitative. The evaluation criteria described in **Section 4.6.1** are specified by the EPA RI/FS guidance (EPA 1988); however, the degree to which the criteria are weighted against each other is not specified. Determination of how the individual evaluation criterion should influence the overall rankings is subjective and based on site-specific considerations and professional judgment.

The factors considered for each of the three criteria that justify retention or elimination are rated using the qualitative rating system. For the effectiveness and implementability criteria, a “low” rating was the least preferable and a “high” rating was the most preferable. For relative cost criteria, a “low” rating indicated a relatively low cost (most preferable) while a “high” rating indicated a relatively high cost (least preferable).

For each LAA-impacted media, remedial technologies or process options deemed to have low effectiveness, low implementability, and/or high relative cost are eliminated from further consideration in the FS for development of remedial alternatives and are indicated on **Tables 4-2a through 4-2d** using gray shading. The factors considered for each of the three criteria that provide justification for retention or elimination also are summarized.

4.7 SELECTION OF REPRESENTATIVE TECHNOLOGIES

Based on the results of the two-step screening process described in **Sections 4.5** and **4.6**, a reduced number of process options for each of the LAA-impacted media were retained for consideration in the development of remedial alternatives. Although in some cases multiple process options were retained for a given technology, only one of those process options will be selected as a representative technology when assembling remedial alternatives. The other process options that are retained at this step of the FS process could be identified as viable during the remedial design for specific situations or locations. Selection of a representative process option for each technology type will be completed prior to assembly of remedial alternatives.

The retained remedial technologies and process options for LAA-impacted duff, forest soil, forest fire ash, and bark based on effectiveness, implementability, and cost are presented in **Exhibits 4-3 through 4-6**.

Exhibit 4-3. Retained Remedial Technologies and Process Options for Development of Remedial Alternatives –LAA-impacted Duff

Remedial Technology	Process Option
No Action	No Action
Natural Recovery	Monitored Natural Recovery
Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with Institutional Control Components
Risk Communication Controls	Information and Education Programs/Notification Programs
Access and Use Management	Access and Use Management
Surface Source Controls	In-Situ Mixing
Surface Source, Erosion, and Migration Controls	Covers / Barriers: Soil or Rock
	Covers / Barriers: Vegetative
	Slash Spreading
Migration and Erosion Controls	Contour Log Terraces
	Straw Wattles
	Straw Bale Check Dams
Removal	Mechanical Removal (Excavation)
Transport	Mechanical Transport (Hauling/Conveying)
Disposal	Disposal (Former Mine Area)
Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Consolidated Duff
	Open Burning of Consolidated Duff

Exhibit 4-4. Retained Remedial Technologies and Process Options for Development of Remedial Alternatives –LAA-impacted Forest Soil

Remedial Technology	Process Option
No Action	No Action
Natural Recovery	Monitored Natural Recovery
Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with Institutional Control Components
Risk Communication Controls	Information and Education Programs/Notification Programs
Access and Use Management	Access and Use Management
Surface Source Controls	In-Situ Mixing
Surface Source, Erosion, and Migration Controls	Covers / Barriers: Soil or Rock
	Covers / Barriers: Vegetative
	Slash Spreading
Migration and Erosion Controls	Contour Log Terraces
	Straw Wattles
	Straw Bale Check Dams
Removal	Mechanical Removal (Excavation)
Transport	Mechanical Transport (Hauling/Conveying)
Disposal	Disposal (Former Mine Area)

Exhibit 4-5. Retained Remedial Technologies and Process Options for Development of Remedial Alternatives –LAA-impacted Forest Fire Ash – Prevention, Minimization, and Mitigation

Applicability	Remedial Technology	Process Option
Before, During, and After a Forest Fire	No Action	No Action
	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with Institutional Control Components
	Risk Communication Controls	Information and Education Programs/Notification Programs
Before and After a Forest Fire	Access and Use Management	Access and Use Management
	Forest and Fire Management	Vegetation Management
Before a Forest Fire	Removal	Logging (Forwarding, Skidding, Cable)
	Transport of Slash (Former Mine Area)	Mechanical Transport
	Transport of Processed Timber (Outside of the OU3 Study Area)	Logging Trucks
	Disposal	Disposal of Slash (Former Mine Area)
	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Slash Generated from Logging
		Slash Pile Burn for Slash Generated from Logging
During a Forest Fire	Surface Source Controls	Water and/or Chemical Based Suppression
After a Forest Fire	Surface Source Controls	In-Situ Mixing
	Surface Source, Erosion, and Migration Controls	Covers / Barriers – Soil or Rock
		Covers / Barriers – Vegetative
		Slash Spreading
	Migration and Erosion Controls	Contour Log Terraces
		Straw Wattles
		Straw Bale Check Dams
	Removal	Mechanical Removal
	Transport	Mechanical Transport
	Disposal	Disposal (Former Mine Area)

Exhibit 4-6. Retained Remedial Technologies and Process Options for Development of Remedial Alternatives –LAA-impacted Bark

Remedial Technology	Process Option
No Action	No Action
Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with Institutional Control Components
Risk Communication Controls	Information and Education Programs/Notification Programs
Access and Use Management	Access and Use Management
Removal	Logging and Processing (Forwarding, Skidding, Cable)
Transport of Slash (Former Mine Area)	Mechanical Transport
Transport of Processed Timber (Outside of the OU3 Study Area)	Logging Trucks
Disposal of Slash	Disposal of Slash (Former Mine Area)
Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Slash Generated from Logging
	Slash Pile Burn for Slash Generated from Logging

Remedial technologies and process options identified to address each of the LAA-impacted media are retained because they either have substantial potential and applicability as a stand-alone remedy, or have remedial benefits in combination with other remedial technologies. It is unlikely that using or applying a single remedial technology/process option to the LAA-impacted media will be able to achieve the PRAOs or comply with all ARARs. Thus, using various remedial technologies/process options in combination is likely to be necessary in the assembly of remedial alternatives that occurs within the subsequent memorandum.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACD	Air Curtain Destructor
ARAR	applicable or relevant and appropriate requirements
ATV	all-terrain vehicle
BERA	baseline ecological risk assessments
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DOT	US Department of Transportation
EPA	US Environmental Protection Agency
FRTR	Federal Remediation Technologies Roundtable
FS	Feasibility Study
GRA	general response action
HHRA	human health risk assessments
LAA	Libby Amphibole Asbestos
MDEQ	Montana Department of Environmental Quality
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PRAO	preliminary remedial action objectives
RA	remedial action
RAO	remedial action objective
RD	Remedial Design
RI	remedial investigation
ROD	record of decision
TBC	to be considered
U.S.C.	United States Code
USFS	US Forest Service



Tables

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Table 4-1a
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^a	Retained?
No Action	None	None	No action would be taken. Libby Amphibole Asbestos (LAA)-impacted duff would remain in its existing conditions.	Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as baseline for comparison.	Yes
Monitoring	Natural Recovery	Monitored Natural Recovery	Duff material is generated from falling branches, stems, leaves, needles, and pine cones, and then decomposed into soil. Because the mining operations (e.g., mining, milling, and processing vermiculite) ceased decades ago, the concentration of LAA from mining operations in the materials contributing to the duff will diminish naturally over time. Forest materials not impacted by mining activities will fall and decompose on the forest floor. LAA fibers in the duff material will continue to mix with un-impacted duff material and be buried by un-impacted duff material, which will then decompose and become un-impacted soil. A monitoring program would evaluate the rate of decline of LAA fibers from mining activities at established intervals (e.g., in advance of each Five Year Review) to track the progress of natural recovery.	Potentially implementable process option.	Yes
Institutional Controls (ICs)	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments (e.g., administrative or legal) that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Some examples may include zoning restrictions, area closures and/or restrictions, building or excavation permits, well drilling prohibitions, easements, and covenants.	Potentially implementable process option depending on type of IC applied and scope of action.	Yes
	Risk Communication Controls	Information and Education Programs/ Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted duff. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted duff in specific areas, or for specific activities.	Potentially implementable process option.	Yes
Engineering Controls	Access and Use Management	Access and Use Management	Use of and access to select areas with LAA-impacted duff would be managed by engineering controls (e.g., fencing and warning signs) to reduce exposure resulting from certain human activities.	Potentially implementable process option depending on type of action applied and scope of action.	Yes
Containment	Surface Source Controls	Water-Based Suppression	Select areas of LAA-impacted duff would be kept moist (e.g., by an irrigation system) using water or a water-based dust suppressant to limit migration of LAA-impacted duff.	Potentially implementable process option to a very limited area for a limited timeframe. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations for equipment used to apply water, density of trees, steep terrain, and areal extent.	Yes
		Chemical-Based Suppression	Select areas of LAA-impacted duff would be treated with a resinous or petroleum-based chemical dust suppressant (e.g., DusTreat™ DC9136) to limit migration of LAA-impacted duff. Chemical-based suppression is applied using equipment such as foamers, hydro-seeders or re-plumbed spraying trucks.	Potentially implementable process option to a limited area for a limited timeframe. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations for equipment used to spray dust suppressant, density of trees, steep terrain, and areal extent.	Yes

Table 4-1a
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^a	Retained?
Containment (continued)	Surface Source Controls	In-Situ Mixing	Select areas of LAA-impacted duff would be mixed (e.g., using a cultivator, disk harrows) with underlying un-impacted soil or fill materials to limit migration of LAA-impacted duff.	Potentially implementable process option for limited areas of the Phase 1 Area if the approach is limited to surface mixing. Not technically implementable for application to the majority of the Phase 1 Area due to access limitations to LAA-impacted duff areas, steep terrain, density of trees and roots, areas of shallow bedrock, and the areal extent of the LAA-impacted duff. Deep auger mixing is not considered technically implementable because even with clear cutting, remaining tree and plant roots would hinder the deeper mixing and likely damage equipment.	Yes
	Surface Source, Erosion, and Migration Controls	Covers / Barriers: Soil or Rock	Select areas of LAA-impacted duff would be covered with a layer of clean soil or rock with sufficient thickness to reduce exposure risks to receptors and limit migration of LAA-impacted duff.	Potentially implementable process option for limited areas of the Phase 1 Area. A soil or rock cover is not technically implementable for application to the majority of the Phase 1 Area due to access limitations to all LAA-impacted duff, steep terrain, density of trees, and the areal extent of the LAA-impacted duff.	Yes
		Covers / Barriers: Asphalt or Concrete	Select areas of LAA-impacted duff would be covered with layers of asphalt or concrete with sufficient thickness to limit migration of LAA-impacted duff (shotcrete, poured, or rolled).	Potentially implementable process option for limited areas of the Phase 1 Area. An asphalt or concrete cover is not technically implementable for application to the majority of the Phase 1 Area due to access limitations to LAA-impacted duff, steep terrain, and density of trees making it difficult to distribute the materials over the duff.	Yes
		Covers / Barriers: Geosynthetic Multi-Layer Exposure Barrier/Cover	Select areas of LAA-impacted duff would be covered with geosynthetic material (e.g., geomembrane or a geosynthetic clay liner [GCL]) along with protective vegetative or rock layers to limit migration of LAA-impacted duff.	A geosynthetic multi-layer barrier/cover is not considered to be a technically implementable process option for limited or larger areas of the Phase 1 Area. Areas of steep terrain would result in access limitations making it difficult to lay the materials down over the duff. The cover is not considered an implementable process option for even limited areas because even with clearing of trees and understory the remaining tree stumps would hinder or prevent even and consistent application and seaming of the geosynthetic liner to achieve permeability requirements.	No
		Covers / Barriers: Vegetative Cover	Select areas of LAA-impacted duff would be covered with a vegetative layer established by application of soil and/or soil amendments (e.g., compost, hydromulch, biochar) and seed mix (e.g., indigenous grasses and plants) by aerial or land application to limit migration of LAA-impacted duff .	Potentially implementable process option to limited and larger areas depending on application technique. Aerial applications and sprayed applications of vegetative cover materials expand applicability to remote and steep areas of the Phase 1 Area (Robichaud <i>et al.</i> , 2000).	Yes
		Slash Spreading	Tree limbs and branches can be spread on select areas of duff and soil to reduce raindrop impact. If branches are cut small enough (slashed) so that they come in contact with the soil, they also will help disperse overland water flow and reduce runoff and erosion.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
	Migration and Erosion Controls	Contour Log Terraces	Dead trees are felled, limbed, and placed on the contour perpendicular to the direction of the slope. Logs are placed in an alternating configuration so runoff is diverted and reduced in velocity giving water time to percolate into the soil.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
		Straw Wattles	Straw wattles are long tubes of plastic netting packed with excelsior, straw, or other material. Wattles are used in a similar fashion to log terraces. The wattle is flexible enough to bend to the contour of the slope.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
		Straw Bale Check Dams	Straw bales placed in small drainages act as a dam collecting sediments from upslope and slowing the velocity of water traveling down the slope. Bales are placed in rows with overlapping joints.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent.	Yes

Table 4-1a
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^a	Retained?
Removal, Transport, Disposal	Removal	Pneumatic Removal (Vacuum Extraction/Pumping)	Select areas of LAA-impacted duff would be removed using vacuum hoses, vacuum trucks, or other pneumatic conveyance system.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent. A single removal event may not be sufficient since deposition of new duff from trees may be LAA-impacted. Select tree removal prior to duff removal would reduce future impacts if a single removal event was desired (see Table 4-1d for descriptions on logging methodology and feasibility for the Phase 1 Area).	Yes
		Mechanical Removal (Excavation)	Select areas of LAA-impacted duff would be removed using mechanical excavation methods.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent. A single removal event may not be sufficient since deposition of new duff from trees may be LAA-impacted. Select tree removal prior to duff removal would reduce future impacts if a single removal event was desired (see Table 4-1d for descriptions on logging methodology and feasibility for the Phase 1 Area).	Yes
	Transport	Mechanical Transport (Hauling/Conveying)	Select areas of LAA-impacted duff would be transported by truck or other mechanical conveyance method.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
		Hydraulic Transport (Slurrying)	Select areas of LAA-impacted duff would be transported in slurry form using a pipeline or other hydraulic conveyance system.	Not technically implementable for application to all LAA-impacted duff due to access limitations, steep terrain, and the areal extent of the LAA-impacted duff. Hydraulic transport could not be applied to smaller areas because this method is only suitable for small particle sizes and not applicable to duff (e.g., duff would not form a slurry if mixed with water for transport). Treatment of water used for transport would be required, and it is only useful for actions in close proximity to disposal locations.	No
		Pneumatic Transport (Vacuum Extraction/Pumping)	Select areas of LAA-impacted duff would be transported using vacuum hoses, vacuum trucks, or other pneumatic conveyance system to disposal site.	Potentially implementable process option for limited areas if a portable vacuum truck is used. It is not technically feasible for application to all areas where LAA may be present in duff due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
		Disposal	Disposal (Former Mine Area)	Disposal at the Former Mine Area could be implemented for removable and transportable quantities of duff.	Yes
			Disposal (Outside OU3 Study Area)	Disposal at a site outside of the OU3 Study Area is technically implementable because Class IV Landfills accept friable asbestos materials. It is only implementable for removable and transportable quantities of duff.	Yes
	Biological, Chemical, and/or Physical Treatment	Bioremediation by Plants and Fungi (In-situ) (Daghino et al, 2006; Martino et al, 2003, 2004)	Indigenous fungi and plants are colonized on the duff to transform the LAA asbestos through the production of metal chelators which extract iron ions from the fibers. Lab studies have shown fungi (particularly <i>Fusarium oxysporum</i>) to be effective at breaking down the iron-containing asbestos crystals. Iron contributes to the toxicity of asbestos to humans when inhaled. In addition to the effects on mineral structure, plants, lichens and fungi tolerant of asbestos-rich materials can physically weather or bind asbestos minerals and limit dispersion of fibers into the air, thus reducing the potential for inhalation.	This process option has not been demonstrated for large-scale remediation of LAA-containing media. Additionally, mineral transformation by fungi and plants has only been shown for asbestos containing iron, and LAA contains other forms (e.g., richterite) (Leake <i>et al.</i> , 1997, Meeker <i>et al.</i> , 2003) and is therefore not considered an implementable process option.	No
		Vermicultural process (Vermiprocess) (Ex Situ)	Worms are employed to convert LAA-impacted duff into a non-regulated material. The process requires removal and transfer of LAA-impacted duff to a bin containing vermicompost.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Vermicompost has not been demonstrated to be an effective treatment for asbestos (Schreier <i>et al.</i> , 1985) and is therefore not considered an implementable treatment option.	No

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Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^a	Retained?
Treatment (continued)	Biological, Chemical, and/or Physical Treatment (continued)	Pozzolan- or Cement-Based Stabilization/ Solidification (Ex Situ)	Select areas of LAA-impacted duff would be mixed ex situ with a pozzolan- or cement-based binding agent before disposal.	Removal and transport of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted duff because it is difficult to obtain and transport large quantities of binding agents and the heterogeneity of the duff would make homogenization with the binding agent difficult.	No
		Pozzolan- or Cement-Based Stabilization/ Solidification (In Situ)	Select areas of LAA-impacted duff would be mixed in situ with a pozzolan- or cement-based binding agent using a deep soil auger mixing/injection technique.	The deep soil auger mixing/injection technique is not implementable for the site due to access limitations to all LAA-impacted duff, steep terrain, density of trees and roots, areas of shallow bedrock, and the areal extent of LAA-impacted duff. It would not be applicable to smaller areas because tree and plant roots would hinder deep auger mixing and likely damage equipment, and the underlying materials (e.g., soil, bedrock) may contain LAA, so treatment of those media would need to occur as well.	No
		Chemical Decomposition (Ex Situ)	The LAA within the duff would be decomposed to an amorphous silica suspension at relatively low temperatures (approximately 100 degrees Celsius [°C]) using chemicals tailored to the waste stream. The resulting amorphous silica would then be solidified for disposal as a nonregulated waste. ABCOV™ is a demonstrated form of this process option.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Implementation requires the physical separation and segregation of LAA-impacted materials into similar materials and sizes. Given the heterogeneity of and volume of LAA-impacted duff, separation/segregation would be extremely labor intensive and thus Chemical Decomposition is not considered an implementable treatment option.	No
		Chemical Digestion (In Situ)	Select areas of LAA-impacted duff would be treated using a spray-applied foam that soaks into porous materials and converts chrysotile asbestos contained within to an inert, non-fibrous form. Digestion Material for Asbestos (DMA®) is a commercial form of this process option.	Chemical digestion is not technically implementable for site application because the process option is only applicable to chrysotile-asbestos-containing porous materials that can readily absorb the digestion agent, and the process option does not affect amphibole asbestos.	No
		Soil Washing (Ex Situ)	Select areas of LAA-impacted duff would be flushed with a Site-specific washing solution; flushed LAA would be collected for further treatment and/or disposal. The process option relies on removal by particle size separation or dissolving/suspending LAA in a wash solution by chemical means.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. The treatment process option was developed for use with soil so its use with duff is uncertain. Due to the heterogeneity and volume of duff material and the need to treat the aqueous waste stream, soil washing is not considered an implementable treatment option.	No
		Soil Flushing (In Situ)	A washing solution (as with soil washing) would be circulated through select areas of LAA-impacted duff with the use of injection and extraction wells or trenches; flushed LAA would be collected for further treatment and/or disposal.	Soil flushing is not technically implementable for site application due to access limitations to LAA-impacted duff areas, steep terrain, density of trees and roots, areas of shallow bedrock, and the areal extent of the LAA-impacted duff. This process option has not been demonstrated for use with asbestos. Additionally, soil flushing is a subsurface treatment, thus LAA-impacted duff would need to be mixed with soil via deep auger mixing prior to treatment application. Deep auger mixing is not feasible for reasons stated above under In Situ Mixing process option.	No
		Vitrification (In Situ)	An electrical current would be passed between electrodes inserted into select areas of LAA-impacted duff to melt the materials at extremely high temperatures (1,600 to 2,000 Celsius (°C)). The melted matrix is then allowed to cool in place into a solid vitrified glass mass, thereby eliminating the inhalation route of exposure and reducing potential for migration of LAA-impacted duff.	The process option relies on the electrical conductivity of the materials making implementation difficult, and it requires a reliable source of electrical power, which is not available at the site so mobile generators would need to be used. The energy required to overcome the resistance of the materials is high, therefore vitrification is not considered an implementable process option.	No

Table 4-1a
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^a	Retained?
Treatment (continued)	Thermal Treatment	Electric Arc Vitrification (Ex Situ)	An electrical current would be passed between electrodes in a furnace creating an electrical arc. LAA-impacted duff from select areas would be placed in the furnace to form a molten bath that cools to form a vitrified glass mass. The vitrified glass mass is an inert waste.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Debris greater than 60 millimeters (mm) in diameter must be removed prior to processing. As such, ex situ vitrification is not implementable for even smaller volumes (i.e., removable and transportable) of duff.	No
		Plasma Arc Vitrification (Ex Situ)	An electrical current would be passed between electrodes to form plasma. LAA-impacted duff from select areas would be placed in the plasma arc form a molten bath that cools to form a vitrified glass mass. The vitrified glass mass is an inert waste.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Debris greater than 60 mm in diameter must be removed prior to processing, and the units only have the ability to treat small (3 to 5 tons/day) volumes of LAA-impacted materials. As such, ex situ vitrification is not implementable for even smaller (i.e., removable) volumes of duff.	No
		Incineration (Ex Situ)	Removed volumes of LAA-impacted duff would be subjected to incineration without chemical additives.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. There are specific feed-size and materials-handling requirements that would impact implementability for even smaller (i.e., removable, transportable) volumes of duff.	No
		Thermo-Caustic Dissolution (Ex Situ)	Removed volumes of LAA-impacted duff would be placed into a high temperature caustic (strong basic) solution. Asbestos fibers are partially to fully converted (changed to an amorphous structure) during immersion. Partially converted LAA is further converted using chemical reactions to form a viscous mixture, which is later vitrified. The resulting reaction product (glass) is an amorphous inert waste.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of this process option to smaller (i.e., removable, transportable) volumes of LAA-impacted duff is not feasible from a materials handling perspective since size reduction and removal of rocks would need to occur prior to treatment.	No
		Thermo-Chemical Treatment (Ex Situ)	Removed volumes of LAA-impacted duff would be mixed with proprietary demineralizing agents within a hydrofluoric acid solution. The mixture is then heated in a rotary hearth furnace. This process is similar to vitrification but does not involve complete melting. Instead, the process results in partial sintering of the material. The resulting reaction product (rocklike material) is an inert waste. Thermo-chemical conversion technology (TCCT), patented by ARI Technologies Inc., is a commercial form of this technology.	Removal of LAA-impacted duff is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of this process option to smaller (i.e., removable, transportable) volumes of LAA-impacted duff is not feasible from a materials handling perspective since size reduction and removal of rocks would need to occur prior to treatment.	No
	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Consolidated Duff	An ACD would be used in select areas to condense and potentially treat the LAA-impacted duff material for disposal at the Former Mine Area. The ACD firebox can be either a mobile above ground unit or an in-ground pit dug into the ground. The in-ground ACD design would include a pit dug into the ground with a transportable blower and curtain air plenum positioned to blow the curtain air over and down into pit.	Potentially implementable process option in select areas. The use of in-ground ACDs is common in applications such as destruction of forest-clearing debris because they are relatively light and can be towed into remote areas (Miller and Lemieux, 2007).	Yes
		Open Burning of Consolidated Duff	Duff associated with removal activities would be consolidated into piles and burned, similar to slash pile burning, to reduce volume and facilitate disposal.	Potentially implementable process option in select areas.	Yes

Notes and Abbreviations:

- ACD - Air Curtain Destructor

°C – Degree Celsius

CAG - Community Advisory Group

GCL - geosynthetic clay liner

GRA – General Response Action

ICs - Institutional Controls
- LAA - Libby Amphibole Asbestos

mm - millimeters

NCP - National Oil and Hazardous Substances Pollution Contingency Plan

OU3 – Operable Unit 3

TCCT - Thermo-chemical conversion technology

(a) The screening evaluation of the process option implementability is preliminary because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).

Table 4-1b
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Soil^a
Page 1 of 6

General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^b	Retained?
No Action	None	None	No action would be taken. Libby Amphibole Asbestos (LAA)-impacted forest soil would remain in existing conditions.	Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as baseline for comparison.	Yes
Monitoring	Natural Recovery	Monitored Natural Recovery	For areas where forest soil is covered by duff, the surface is being covered from falling branches, stems, leaves, needles, and pine cones, and then decomposed into soil. Because the mining operations (e.g., mining, milling and processing vermiculite) ceased decades ago, the concentration of LAA from mining operations in the materials contributing to the soil will diminish naturally over time. Forest materials not impacted by mining activities will fall and decompose on the forest floor. LAA fibers in the soil will be buried by un-impacted duff material, which will then decompose and become un-impacted soil. A monitoring program would evaluate the rate of decline of LAA fibers from mining activities at established intervals (e.g., in advance of each Five Year Review) to track the progress of natural recovery.	Potentially implementable process option.	Yes
Institutional Controls (ICs)	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments (e.g., administrative and legal controls) that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Some examples may include zoning restrictions, area closures and/or restrictions, building or excavation permits, well drilling prohibitions, easements, and covenants.	Potentially implementable process option depending on type of IC applied and scope of action.	Yes
	Risk Communication Controls	Information and Education Programs/Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted forest soil. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted forest soil in specific areas, or for specific activities.	Potentially implementable process option.	Yes
Engineering Controls	Access and Use Management	Access and Use Management	Use of and access to select areas with LAA-impacted forest soil would be managed by engineering controls (e.g., fencing and warning signs) to reduce exposure resulting from certain human activities.	Potentially implementable process option depending on type of action applied and scope of action.	Yes
Containment	Surface Source and Controls	Water-Based Suppression	Select areas of LAA-impacted forest soil would be kept moist (e.g., by an irrigation system) using water or a water-based dust suppressant to limit migration of LAA-impacted soil.	Potentially implementable process option to a limited area for a limited timeframe. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations for equipment used to apply water, density of trees, steep terrain, and areal extent.	Yes

Table 4-1b
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Soil^a
Page 2 of 6

General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^b	Retained?
Containment (continued)	Surface Source Controls (continued)	Chemical-Based Suppression	Select areas of LAA-impacted forest soil would be treated with a resinous or petroleum-based chemical dust suppressant (e.g., DusTreat™ DC9136) to limit migration of LAA-impacted soil. Chemical-based suppression is applied using equipment such as foamers, hydro-seeders or re-plumbed spraying trucks.	Potentially implementable process option to a limited area for a limited timeframe. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations for equipment used to spray dust suppressant, density of trees, steep terrain, and areal extent.	Yes
		In-Situ Mixing	Select areas of LAA-impacted forest soil would be mixed (e.g., using a cultivator, disk harrows) with underlying un-impacted forest soil or fill materials to limit migration of LAA-impacted soil.	Potentially implementable process option for limited areas of the Phase 1 Area if the approach is limited to surface mixing. Not technically implementable for application to the majority of the Phase 1 Area due to access limitations to LAA-impacted forest soil, steep terrain, density of trees and roots, areas of shallow bedrock, and the areal extent of the LAA-impacted forest soil. The forest soil is also covered in duff, so in order to access the forest soil, the duff would need to be removed or also treated by In-Situ Mixing. Deep auger mixing is not considered technically implementable because even with clear cutting, remaining tree and plant roots would hinder the deeper mixing and likely damage equipment.	Yes
	Surface Source, Erosion, and Migration Controls	Covers / Barriers: Soil or Rock	Select areas of LAA-impacted forest soil would be covered with a layer of clean soil or rock with sufficient thickness to reduce exposure risks to receptors and limit migration of LAA-impacted soil.	Potentially implementable process option for limited areas of the Phase 1 Area. A soil or rock cover is not technically implementable for application to the majority of the Phase 1 Area due to access limitations to all LAA-impacted forest soil, steep terrain, density of trees, and the areal extent of the LAA-impacted forest soil.	Yes
		Covers / Barriers: Asphalt or Concrete	Select areas of LAA-impacted forest soil would be covered with layers of asphalt or concrete with sufficient thickness to limit migration of LAA-impacted soil (shotcrete, poured, or rolled).	Potentially implementable process option for limited areas of the Phase 1 Area. An asphalt or concrete cover is not technically implementable for application to the majority of the Phase 1 Area due to access limitations to all LAA-impacted soil, steep terrain, and density of trees making it difficult to distribute the materials over the soil.	Yes
		Covers / Barriers: Geosynthetic Multi-Layer Exposure Barrier/Cover	Select areas of LAA-impacted forest soil would be covered with geosynthetic material (such as geomembrane or a geosynthetic clay liner [GCL]) along with protective vegetative or rock layers to limit migration of LAA.	A geosynthetic multi-layer barrier/cover is not considered to be a technically implementable process option for limited or larger areas of the Phase 1 Area. Areas of steep terrain would result in access limitations making it difficult to lay the materials down over the forest soil. The cover is not considered an implementable process option for even limited areas because even with clearing of trees and understory the remaining tree stumps would hinder or prevent consistent application and seaming of the geosynthetic liner to achieve permeability requirements.	No
		Covers / Barriers: Vegetative Cover	Select areas of LAA-impacted forest soil would be covered with a vegetative layer established by application of soil and/or soil amendments (e.g., compost, hydromulch, biochar) and seed mix (e.g., indigenous grasses and plants) by aerial or land application to limit migration of LAA-impacted soil .	Potentially implementable process option to limited and larger areas depending on application technique. Aerial applications and sprayed applications of vegetative cover materials expand applicability to remote and steep areas of the Phase 1 Area (Robichaud <i>et al.</i> , 2000).	Yes
		Slash Spreading	Tree limbs and branches can be spread on select areas of the forest soil to reduce raindrop impact. If branches are cut small enough (slashed) so that they come in contact with the soil, they also will help disperse overland water flow and reduce runoff and erosion.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent.	Yes

Table 4-1b
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Soil^a
Page 3 of 6

General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^b	Retained?
Containment (continued)	Migration and Erosion Controls	Contour Log Terraces	Dead trees are felled, limbed, and placed on the contour perpendicular to the direction of the slope. Logs are placed in an alternating configuration so runoff is diverted and reduced in velocity giving water time to percolate into the soil.	Potentially implementable process option to limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
	Migration and Erosion Controls	Straw Wattles	Straw wattles are long tubes of plastic netting packed with excelsior, straw, or other material. Wattles are used in a similar fashion to log terraces. The wattle is flexible enough to bend to the contour of the slope.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
		Straw Bale Check Dams	Straw bales placed in small drainages act as a dam collecting sediments from upslope and slowing the velocity of water traveling down the slope. Bales are placed in rows with overlapping joints.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
Removal, Transport, Disposal	Removal	Pneumatic Removal (Vacuum Extraction/Pumping)	Select areas of LAA-impacted forest soil would be excavated using vacuum hoses, vacuum trucks, or other pneumatic conveyance system.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent. Duff removal would be required along with, or prior to forest soil removal. A single removal event may not be sufficient since deposition of new duff from trees may be LAA-impacted. Select tree removal prior to soil removal would reduce future impacts if a single removal event was desired (see Table 4-1d for descriptions on logging methodology and feasibility for the Phase 1 Area).	Yes
		Mechanical Removal (Excavation)	Select areas of LAA-impacted forest soil would be excavated using mechanical excavation methods.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent. Duff removal would be required along with or prior to forest soil removal. A single removal event may not be sufficient since deposition of new duff from trees may be LAA-impacted. Select tree removal prior to forest soil removal would reduce future impacts if a single removal event was desired (See Table 4-1d for descriptions on logging methodology and feasibility for the Phase 1 Area).	Yes
	Transport	Mechanical Transport (Hauling/Conveying)	Select areas of LAA-impacted forest soil would be transported by truck or other mechanical conveyance method.	Potentially implementable process option for limited areas. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent.	Yes
		Hydraulic Transport (Slurrying)	Select areas of LAA-impacted forest soil would be transported in slurry form using a pipeline or other hydraulic conveyance system.	Not technically feasible for application to all LAA-impacted forest soil due to access limitations, steep terrain, and the areal extent of the LAA-impacted forest soil. Hydraulic transport is also not considered feasible for smaller areas where removal would be feasible, because treatment of water used for transport would be required and the transport method is only useful for actions in close proximity to disposal locations.	No
		Pneumatic Transport (Vacuum Extraction/Pumping)	Select areas of LAA-impacted forest soil would be transported using vacuum hoses, vacuum trucks, or other pneumatic conveyance system to disposal site.	Potentially implementable process option for limited areas if a portable vacuum truck was used. It is not technically feasible for application to all areas where LAA may be present in forest soil due to the access limitations, density of trees, steep terrain, and areal extent.	Yes

Table 4-1b
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Soil^a
Page 4 of 6

General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^b	Retained?
Removal, Transport, Disposal (continued)	Disposal	Disposal (Former Mine Area)	Select areas of LAA-impacted forest soil would be consolidated and disposed of at the Former Mine Area.	Disposal at the Former Mine Area could be implemented for removable and transportable quantities of forest soil.	Yes
		Disposal (Outside OU3 Study Area)	Select areas of LAA-impacted forest soil would be consolidated and disposed of at a location outside of the OU3 Study Area.	Disposal at a site outside of the OU3 Study Area is technically implementable because Class IV Landfills accept friable asbestos materials. It is only implementable for removable and transportable quantities of forest soil.	Yes
Treatment	Biological, Chemical, and/or Physical Treatment	Bioremediation by Plants and Fungi (In-situ) (Daghino et al, 2006; Martino et al, 2003, 2004)	Indigenous fungi and plants are colonized on the forest soil to transform the LAA asbestos through the production of metal chelators which extract iron ions from the fibers. Lab studies have shown fungi (particularly <i>Fusarium oxysporum</i>) to be effective at breaking down the iron-containing asbestos crystals. Iron contributes to the toxicity of asbestos to humans when inhaled. In addition to the effects on mineral structure, plants, lichens and fungi tolerant of asbestos-rich materials can physically weather or bind asbestos minerals and limit dispersion of fibers into the air, thus reducing the potential for inhalation.	This process option has not been demonstrated for large-scale remediation of LAA containing media. Additionally, mineral transformation by fungi and plants has only been shown for asbestos containing iron, and LAA contains other mineral forms (e.g. richterite) (Leake et al. 1997, Meeker et al. 2003) and is therefore not considered an implementable process option.	No
		Vermicultural process (Vermiprocess) (Ex Situ)	Worms are employed to convert LAA-impacted forest soil into a non-regulated material. The process requires removal and transport of LAA-impacted forest soil to a bin containing vermicompost.	Removal of LAA-impacted forest soil only is feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Vermicompost has not been demonstrated to be an effective treatment for asbestos (Schreier et al, 1985) and is therefore not considered an implementable treatment option.	No
		Pozzolan- or Cement-Based Stabilization/ Solidification (Ex Situ)	Select areas of LAA-impacted forest soil would be mixed with a pozzolan or cement-based binding agent before disposal.	Removal and transport of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted soil because it is difficult to obtain and transport large quantities of binding agents and the heterogeneity of the soil would make homogenization with the binding agent difficult.	No
		Pozzolan- or Cement-Based Stabilization/ Solidification (In Situ)	Select areas of LAA-impacted forest soil would be mixed in situ with a pozzolan- or cement-based binding agent using a deep soil auger mixing/injection technique.	The deep soil auger mixing/injection technique is not feasible for application to the Phase 1 Area due to access limitations to all LAA-impacted forest soil, steep terrain, density of trees and roots, areas of shallow bedrock, and the areal extent of the LAA-impacted forest soil. It would not be applicable to smaller areas because tree and plant roots would hinder deep auger mixing and likely damage equipment, and the underlying materials (e.g., deeper soil, bedrock) may be impacted so treatment of those media would need to occur as well.	No
		Chemical Decomposition (Ex Situ)	The LAA within the forest soil would be decomposed to an amorphous silica suspension at relatively low temperatures (approximately 100 degrees Celsius [°C]) using chemicals tailored to the waste stream. The resulting amorphous silica would then be solidified for disposal as a nonregulated waste. ABCOV TM is a demonstrated form of this technology.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of the process option to smaller (e.g., removable) volumes of forest soil is not feasible because implementation requires the physical separation/segregation of LAA-impacted materials into similar materials and sizes. Given the heterogeneity of and volume of LAA-impacted forest soil in the forested area, separation/segregation would be extremely labor intensive and not feasible.	No

Table 4-1b
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^b	Retained?
Treatment (continued)	Biological, Chemical, and/or Physical Treatment (continued)	Chemical Digestion (In Situ)	Select areas of LAA-impacted forest soil would be treated using spray-applied foam that soaks into porous materials and converts the chrysotile asbestos contained within to an inert, non-fibrous form. Digestion Material for Asbestos (DMA®) is a commercial form of this technology.	Chemical digestion is not technically feasible for application to the Phase 1 Area because the process option is only applicable to chrysotile-asbestos-containing porous materials that can readily absorb the digestion agent, and the process option does not affect amphibole asbestos.	No
		Soil Washing (Ex Situ)	Select areas of LAA-impacted forest soil would be flushed with a site-specific washing solution; flushed LAA would be collected for further treatment and/or disposal. The process option relies on removal by particle size separation or dissolving/suspending LAA in a wash solution by chemical means.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of the process option to smaller (i.e., removable) volumes of soil is not feasible due to the heterogeneity of the soil and the need to treat the aqueous waste stream.	No
		Soil Flushing (In Situ)	A washing solution (as with soil washing) would be circulated through select areas of LAA-impacted forest soil with the use of injection and extraction wells or trenches; flushed LAA would be collected for further treatment and/or disposal.	Soil flushing is not technically implementable for application to the Phase 1 Area due to access limitations to all LAA-impacted forest soil, steep terrain, density of trees and roots, areas of shallow bedrock, and the areal extent of the LAA-impacted forest soil. This process option has not been demonstrated for use with asbestos and is therefore not considered an implementable process option.	No
		Vitrification (In Situ)	An electrical current would be passed between electrodes inserted into LAA-impacted forest soil to melt the materials at extremely high temperatures (1,600 to 2,000°C). The melted matrix is then allowed to cool in place into a solid vitrified glass mass, thereby eliminating the inhalation route of exposure and reducing potential for LAA migration.	The process option relies on the electrical conductivity of the materials making implementation difficult, and it requires a reliable source of electrical power which is not available at the Phase 1 Area so mobile generators would need to be used. The energy required to overcome the resistance of the materials is high; therefore, vitrification is not considered an implementable process option.	No
	Thermal Treatment	Electric Arc Vitrification (Ex Situ)	An electrical current would be passed between electrodes in a furnace creating an electrical arc. LAA-impacted forest soil placed in the furnace form a molten bath that cools to form a vitrified glass mass. The vitrified glass mass is an inert waste.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of this process option to smaller (i.e., removable, transportable) volumes of LAA-impacted forest soil is not feasible because debris or rocks greater than 60 millimeters (mm) in diameter must be removed prior to processing.	No
		Plasma Arc Vitrification (Ex Situ)	An electrical current would be passed between electrodes to form plasma. LAA-impacted forest soil placed in the plasma arc form a molten bath that cools to form a vitrified glass mass. The vitrified glass mass is an inert waste.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Debris or rocks greater than 60 mm in diameter must be removed prior to processing, and the units only have the ability to treat small (3 to 5 tons/day) volumes of LAA-impacted materials. As such, ex situ vitrification is not implementable for even smaller (i.e., removable) volumes of forest soil.	No
		Incineration (Ex Situ)	Removed volumes of LAA-impacted forest soil would be subjected to incineration without chemical additives.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. There are specific feed size and materials handling requirements that would impact applicability to even smaller (i.e., removable, transportable) volumes of soil.	No
		Thermo-Caustic Dissolution (Ex Situ)	Removed volumes of LAA-impacted forest soil would be placed into a high temperature caustic (strong basic) solution. Asbestos fibers are partially to fully converted (changed to an amorphous structure) during immersion. Partially converted LAA is further converted using chemical reactions to form a viscous mixture, which is later vitrified. The resulting reaction product (glass) is an amorphous inert waste.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Thermo-caustic dissolution requires size reduction of the soil and removal of rocks before begin placed in the caustic solution that would impact implementability for even smaller (i.e., removable, transportable) volumes of soil.	No

Table 4-1b
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Soil^a
Page 6 of 6

General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^b	Retained?
Treatment (continued)	Thermal Treatment (continued)	Thermo-Chemical Treatment (Ex Situ)	Removed volumes of LAA-impacted forest soil would be mixed with proprietary demineralizing agents within a hydrofluoric acid solution. The mixture is then heated in a rotary hearth furnace. This process is similar to vitrification but does not involve complete melting. Instead, the process results in partial sintering of the material. The resulting reaction product (rocklike material) is an inert waste. Thermo-chemical conversion technology (TCCT), patented by ARI Technologies Inc., is a commercial form of this technology.	Removal of LAA-impacted forest soil is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of this process option to smaller (i.e., removable, transportable) volumes of LAA-impacted forest soil is also not feasible from a materials handling perspective since size reduction and removal of rocks would need to occur prior to treatment.	No

Notes and Abbreviations:

°C – Degree Celsius

CAG - Community Advisory Group

GCL - geosynthetic clay liner

GRA – General Response Action

ICs - Institutional Controls

LAA - Libby Amphibole Asbestos

NCP - National Oil and Hazardous Substances Pollution Contingency Plan

OU3 – Operable Unit 3

TCCT - Thermo-chemical conversion technology

- (a) Soil along creeks and within drainages will be managed in the Phase II Feasibility Study.
- (b) The screening evaluation of the process option implementability is preliminary because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).

Table 4-1c
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Fire Ash – Prevention, Minimization, and Mitigation
Page 1 of 7

Applicability _{a,b}	General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^c	Retained?
<u>Before</u> , <u>During</u> , and <u>After</u> a Forest Fire	No Action	None	None	No action would be taken to prevent, minimize, or mitigate Libby Amphibole Asbestos (LAA)-impacted forest-fire ash.	Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as baseline for comparison.	Yes
	Institutional Controls (ICs)	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments (e.g., administrative and legal controls) that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Some examples of ICs applicable to forest-fire ash include implementing measures to reduce the chance of a forest fire occurring and measures to protect human receptors during and after a fire. Specifically, legal/administrative controls for forest fire LAA-impacted ash may include but are not limited to: <ul style="list-style-type: none"> - Restrictions on smoking and camp fires on or around the Phase 1 Area - Restrictions on building and maintenance of utility lines that run through or near the Phase 1 Area - Restrictions on storage of flammable liquids - Area closures and/or restrictions - Temporary relocation of residents during a forest fire based on air monitoring action levels (e.g., mandatory evacuation) - Specific emergency response plan/fire management plan for the Phase 1 Area to protect firefighters (modify existing plan based on Remedial Investigation (RI)/Feasibility Study (FS) results) - Access and zoning restrictions after a fire. 	Potentially implementable process option that could vary depending on risks in specific areas.	Yes
		Risk Communication Controls	Information and Education Programs/ Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted forest fire ash. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with forest fires in the Phase 1 Area and the resulting risks associated with LAA-impacted ash in specific areas, or for specific activities.	Potentially implementable process option.	Yes
<u>Before</u> a Forest Fire	Engineering Controls	Access and Use Management	Access and Use Management	Use of and access to select areas with LAA impacts would be managed by engineering controls (e.g., fencing and warning signs) to reduce forest fire risks posed by certain human activities. Engineering controls could be used to prevent human receptors from using select areas for camping or other recreational activities that may increase the risk of forest fire. No smoking and campfire restriction signs in select areas in or near the Phase 1 Area would be another form of engineered control to reduce risk of fire.	Potentially implementable process option in select areas.	Yes
<u>Before</u> and <u>After</u> a Forest Fire		Fire Management Activities	Vegetation Management	Fire prevention and vegetation management activities (e.g., removal of dead and dying underbrush, development and/or maintenance of firebreaks, controlled burns) would be conducted to limit the LAA-impacted forest fire ash. Post-fire activities to limit ash migration and exposure would be specific to each fire and based on standard federal guidelines. Migration and erosion control for ash are discussed below under the section containing process options specific to conditions after a forest fire.	Potentially implementable process option in select areas.	Yes

Table 4-1c
Phase 1 Feasibility Study
Identification and Technical Implementability Screening of Potentially Applicable Remedial Technologies/Process Options
LAA-Impacted Forest Fire Ash – Prevention, Minimization, and Mitigation
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Applicability _{a,b}	General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^c	Retained?
Before a Forest Fire	Removal, Transport, Disposal	Removal of Fire Source Materials	Logging and Processing (Anderson et al, 2012)	Select whole-tree harvesting would be employed to select areas with LAA-impacted bark such that a potential source of LAA-impacted forest-fire ash would be minimized at the Phase 1 Area. LAA-impacted timber would be transported to a central processing area at the Phase 1 Area by forwarders (wheeled machines with an enclosed operator cab and log bunk), skidders (wheeled machine with a set of bottom-opening grapples used to grab, assemble and hold the logs), or cables (system of overhead cables, support towers, and winches to move whole tress of logs from the forest). The central processing area(s) would be used to process trees into products suitable for either household or commercial use (i.e., de-barking). For example, selective logging of trees was completed on the Grace property in the early 1990s which removed approximately 50% of the trees that were present on the Grace property during active mining and processing activities. If another selective logging application were completed that targeted the larger, older trees, the number of trees that remain on the Grace property that existed on the property during active mining and processing activities could be significantly reduced along with any associated risks.	Potentially implementable process option in select areas. The extent of LAA-impacted timber and steep terrain would make it difficult to remove all potential sources.	Yes
		Transport of Slash	Mechanical Transport	LAA-impacted bark and limbs (i.e., slash) generated from processing the timber would be transported by log trucks or other mechanical means to the Former Mine Area for disposal.	Potentially implementable process option depending on scale of logging activities and ability to limit LAA transport during logging activities.	Yes
		Transport of Processed Timber ^d	Logging Trucks	Processed timber ^d (LAA-impacted bark and limbs removed) would be transported by log trucks outside of the OU3 Study Area for household or commercial use.	Potentially implementable process option depending on scale of logging activities and ability to limit LAA transport during processing activities.	Yes
		Disposal	Disposal of Slash (Former Mine Area)	LAA-impacted bark and limbs generated from processing the timber would be disposed of at the Former Mine Area.	Potentially implementable process option depending on scale of logging activities. Size reduction of bark and limbs may need to be conducted at the processing area prior to disposal at the Former Mine Area.	Yes
			Disposal of Slash (Outside OU3 Study Area)	LAA-impacted bark and limbs generated from processing the timber would be consolidated and disposed of at a landfill that accepts friable asbestos waste (e.g., Class IV Landfill).	Disposal at a site outside of the OU3 Study Area is technically implementable because Class IV Landfills accept friable asbestos materials. It is only implementable for removable and transportable quantities of slash.	Yes
	Treatment	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Slash Generated from Logging	Air curtain destructors (ACD) would be used in conjunction with logging and vegetation management to condense and potentially treat the LAA-impacted bark, limbs, tops removed from the trees at the central processing area(s). The ACD firebox can be either a mobile above ground unit or an in-ground pit dug into the ground. The in-ground ACD design would include a pit dug into the ground with a transportable blower and curtain air plenum positioned to blow the curtain air over and down into pit.	Potentially implementable process option in select areas. The use of in-ground ACDs is common in applications such as destruction of forest-clearing debris because they are relatively light and can be towed into remote areas (Miller and Lemieux, 2007).	Yes
			Slash Pile Burn for Slash Generated from Logging	Slash pile burning would be used in conjunction with logging and vegetation management to condense the LAA-impacted bark, limbs, and tops removed from the trees at the central processing area(s).	Potentially implementable process option in select areas.	Yes

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Applicability _{a,b}	General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^c	Retained?
<u>During</u> a Forest Fire	Containment	Surface Source Control	Water- and/or Chemical-Based Suppression	During a forest fire, the ash generated would be contained taking into consideration the procedures outlined in the Wildfire Response Guide for Fire Management Unit 3 (FMU3) (Appendix I of the Kootenai Interagency Dispatch Center Operating Guide) (USDA Forest Service, 2014), modified as appropriate based on the RI/FS results and modified further after implementation of remedy for adjustment based upon reduction of risk. Guidelines addressing LAA risks into firefighting procedures may include: <ul style="list-style-type: none"> - Use of aviation as first response - Remain outside the fire perimeter - Utilize a wet line to contain and control fire - Respirator requirements - Decontamination procedures for personnel - Personnel tracking - Decontamination/disposal of equipment and supplies - Air monitoring 	These guidelines would be applied if a fire occurs in the Phase 1 Area or in a narrower area based on the RI/FS results and implementation of remedies. A combination of water- and chemical-based suppression during a forest fire would fight and control the fire and would in turn reduce the amount of ash generated. Under the current Wildfire Response Guide for FMU3, Rainy Creek and the ponds at the mine site in the OU3 Study Area are not used as water sources, and aviation would be the initial and primary means of attack. These measures should be re-evaluated based on the RI/FS results and remedies.	Yes
<u>After</u> a Forest Fire	Monitoring	Natural Recovery	Monitored Natural Recovery	The natural regeneration process that takes place after a fire results in re-vegetation of the forest floor and new seedling establishment. The regrowth of forest floor vegetation would provide containment of LAA-impacted forest fire ash. Growth of new vegetation would provide erosion and migration control, and generation of forest litter (i.e., duff) from the new growth would cover the ash and act as a surface source control. A monitoring program would evaluate the rate at which vegetation was re-established.	Potentially implementable process option.	Yes
	Containment	Surface Source Control	Water Based Suppression	For a limited time after a forest fire, LAA-impacted ash would be kept wet using water or a water-based dust suppressant to minimize exposures from inhalation of LAA-impacted forest fire ash and limit migration of LAA-impacted ash.	Potentially implementable option for a limited area for a limited timeframe. The feasibility depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. It is not technically feasible for application to all areas where LAA may be present in ash due to the access limitations for equipment used to apply water, density of trees, steep terrain, and potential extent.	Yes
			Chemical-Based Suppression	After a forest fire, LAA-impacted ash would be treated with a resinous or petroleum-based chemical dust suppressant (e.g., DusTreat™ DC9136) to limit migration of LAA-impacted ash. Chemical-based suppression is applied using equipment such as foamers, hydro-seeders or re-plumbed spraying trucks.	Potentially implementable process option for a limited area for a limited timeframe. The feasibility depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. It is not technically feasible for application to all areas where LAA may be present in ash due to the access limitations for equipment used to apply dust suppressant, density of trees, steep terrain, and potential extent.	Yes
			In-Situ Mixing	After a forest fire, LAA-impacted ash would be mixed (e.g., using a cultivator, disk harrows) with underlying un-impacted soil or fill materials to limit migration of LAA-impacted ash.	Potentially implementable process option for limited areas if the approach is limited to surface mixing. It is not technically feasible for application to all areas where LAA may be present in ash due to access limitations, steep terrain, density of trees and roots, and areas of shallow bedrock. The feasibility also depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Deep auger mixing is not considered technically implementable because even with clear cutting, remaining tree and plant roots would hinder the deeper mixing and likely damage equipment.	Yes
		Surface Source, Erosion, and Migration Control	Covers / Barriers: Soil or Rock	Selected areas of LAA-impacted ash would be covered with a layer of clean soil or rock with sufficient thickness to reduce exposure risks to receptors, limit migration of LAA-impacted ash, and provide post-fire erosion control.	Potentially implementable option for limited areas. It is not technically implementable for application to the majority of the Phase 1 Area due to access limitations steep terrain, and density of trees making it difficult to distribute over the ash. The feasibility also depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash.	Yes

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Applicability _{a,b}	General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^c	Retained?
After a Forest Fire (continued)	Containment (continued)	Surface Source, Erosion, and Migration Control (continued)	Covers / Barriers: Asphalt or Concrete	Selected areas of LAA-impacted ash would be covered with layers of asphalt or concrete with sufficient thickness to limit migration of LAA-impacted ash and provide post-fire erosion control (shotcrete, poured, or rolled).	Potentially implementable process option for limited areas. An asphalt or concrete cover is not technically implementable for application to the majority of the Phase 1 Area due to access limitations, steep terrain, and density of trees making it difficult to distribute over the ash.	Yes
			Covers / Barriers: Geosynthetic Multi-Layer Exposure Barrier/Cover	Selected areas of LAA-impacted ash would be covered with geosynthetic material (such as geomembrane or a geosynthetic clay liner [GCL]) along with protective vegetative or rock layers to limit migration of LAA-impacted ash and provide post-fire erosion control.	A geosynthetic multi-layer barrier/cover is not considered to be an implementable process for limited or larger areas. Trees and areas of steep terrain would result in access limitations making it difficult to lay the materials down over the ash. The cover is not considered an implementable process option for even limited areas because even with clearing of trees and understory, the remaining tree stumps would hinder or prevent consistent application and seaming of the geosynthetic liner to achieve permeability requirements.	No
			Covers / Barriers: Vegetative Cover	Selected areas of LAA-impacted ash would be covered with a vegetative layer established by application of soil and/or soil amendments (e.g., compost, hydromulch, biochar) and seed mix (e.g., indigenous grasses and plants) by aerial or land application to limit migration of LAA-impacted ash.	Potentially implementable process option to limited and larger areas depending on application technique. Aerial applications and sprayed applications of vegetative cover materials expand applicability to remote and steep areas of the Phase 1 Area (Robichaud <i>et al.</i> , 2000).	Yes
			Slash Spreading	Tree limbs and branches can be spread on the soil to reduce raindrop impact. If branches are cut small enough (slashed) so that they come in contact with the soil, they also will help disperse overland water flow and reduce runoff and erosion.	Potentially implementable process option in select areas. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees making it difficult to distribute over the ash.	Yes
		Migration and Erosion Controls	Contour Log Terraces	Dead trees are felled, limbed, and placed on the contour perpendicular to the direction of the slope. Logs are placed in an alternating configuration so runoff is diverted and reduced in velocity giving water time to percolate into the soil.	Potentially implementable process option in select areas. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees.	Yes
			Straw Wattles	Straw wattles are long tubes of plastic netting packed with excelsior, straw, or other material. Wattles are used in a similar fashion to log terraces. The wattle is flexible enough to bend to the contour of the slope.	Potentially implementable process option in select areas. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees.	Yes
			Straw Bale Check Dams	Straw bales placed in small drainages act as a dam collecting sediments from upslope and slowing the velocity of water traveling down the slope. Bales are placed in rows with overlapping joints.	Potentially implementable process option in select areas. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees.	Yes
	Removal, Transport, Disposal	Removal	Pneumatic Removal	Select areas of LAA-impacted ash would be removed using vacuum hoses, vacuum trucks, or other pneumatic conveyance system.	Potentially implementable process option for limited areas. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations steep terrain, and density of trees. The feasibility also depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Removed ash would likely be a mixed waste containing ash, partially combusted woody debris and duff, soil and rock.	Yes
			Mechanical Removal	Select areas of LAA-impacted ash would be removed using mechanical methods.	Potentially implementable process option for limited areas. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees. The feasibility depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Forest-fire ash would be difficult to collect by mechanical means due to its physical properties and coating on plant/tree/rock surfaces but ash on the ground could be removed by mechanical means if underlying materials were also removed (e.g., remaining duff, soil). Removed ash would likely be a mixed waste containing ash, partially combusted woody debris and duff, soil and rock.	Yes

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After a Forest Fire (continued)	Removal, Transport, Disposal (continued)	Transport	Pneumatic Transport	Select areas of LAA-impacted ash would be transported using vacuum hoses, vacuum trucks, or other pneumatic conveyance system to disposal site.	Potentially implementable process option for limited areas if a portable vacuum truck was used. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees.	Yes
			Mechanical Transport	Select areas of LAA-impacted ash would be transported by truck or other mechanical conveyance method.	Potentially implementable process option for limited areas. The feasibility depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. It is not technically implementable for application to all areas where LAA may be present in ash due to access limitations, steep terrain, and density of trees.	Yes
			Hydraulic Transport	Select areas of LAA-impacted ash would be transported in slurry form using a pipeline or other hydraulic conveyance system.	Hydraulic transport is not technically feasible for LAA-impacted ash due to access limitations, steep terrain, and the potential extent of LAA-impacted ash. Hydraulic transport could not be applied to smaller areas because treatment of water used for transport would be required and the transport method is only useful for actions in close proximity to disposal locations.	No
		Disposal	Disposal (Former Mine Area)	Select areas of LAA-impacted ash would be consolidated and disposed of at the Former Mine Area.	Disposal at the Former Mine Area could be implemented for removable and transportable quantities of ash. It is only implementable for removable and transportable quantities of ash.	Yes
			Disposal (Outside OU3 Study Area)	Select areas of LAA-impacted ash would be consolidated and disposed of at a location outside of the OU3 Study Area.	Disposal at a site outside of the OU3 Study Area is technically implementable because Class IV Landfills accept friable asbestos materials. It is only implementable for removable and transportable quantities of ash.	Yes
	Treatment	Biological, Chemical, and/or Physical Treatment	Bioremediation by Plants and Fungi (In-situ) (Daghino et al, 2006; Martino et al, 2003, 2004)	Indigenous fungi and plants are colonized on the LAA-impacted ash to transform the LAA through the production of metal chelators which extract iron ions from the fibers. Lab studies have shown fungi (particularly <i>Fusarium oxysporum</i>) to be effective at breaking down the iron-containing asbestos crystals. Iron contributes to the toxicity of asbestos to humans when inhaled. In addition to the effects on mineral structure, plants, lichens and fungi tolerant of asbestos-rich materials can physically weather or ‘bind up’ asbestos minerals and limit dispersion of fibers into the air, thus reducing the potential for inhalation.	The process option has not been demonstrated for large-scale remediation of LAA containing media. Additionally, mineral transformation by fungi and plants has only been shown for asbestos containing iron, and LAA contains other mineral forms (e.g. richterite) (Leake et al. 1997, Meeker et al. 2003) and is therefore not considered an implementable process option.	No
			Vermicultural process (Vermiprocess) (Ex Situ)	Worms are employed with the LAA-impacted ash to a composter to convert LAA-impacted ash into a non-regulated material. This process requires removal and transfer of LAA-impacted ash to a bin containing vermicompost.	Removal of LAA-impacted ash is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Vermicompost has not been demonstrated to be an effective treatment for asbestos (Schreier et al., 1985) and is therefore not considered an implementable treatment option.	No
			Pozzolan- or Cement- Based Stabilization/ Solidification (Ex Situ)	Select areas of LAA-impacted ash would be mixed with a pozzolan or cement-based binding agent before disposal.	The feasibility depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Removal of LAA-impacted ash is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted ash because it is difficult to obtain and transport large quantities of binding agents for homogenization with the ash.	No
			Pozzolan- or Cement- Based Stabilization/ Solidification (In Situ)	Select areas of LAA-impacted ash would be mixed in situ with a pozzolan- or cement-based binding agent using a deep soil auger mixing/injection technique.	The deep soil auger mixing/injection technique could not be applied to LAA-impacted ash in situ due to access limitations, steep terrain, density of remaining trees, roots, areas of shallow bedrock, and the potential areal extent of the LAA-impacted ash. It would not be applicable to smaller areas because tree and plant roots would hinder mixing and likely damage equipment, and the underlying materials (e.g., soil, bedrock) may contain LAA so treatment of those media would need to occur as well.	No

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Applicability _{a,b}	General Response Action	Remedial Technology	Process Option	Description of Option	Screening Comments ^c	Retained?
After a Forest Fire (continued)	Treatment (continued)	Biological, Chemical, and/or Physical Treatment (continued)	Chemical Decomposition (Ex Situ)	The LAA within the ash would be decomposed to an amorphous silica suspension at relatively low temperatures (approximately 100 degrees Celsius [°C]) using chemicals tailored to the waste stream. The resulting amorphous silica would then be solidified for disposal as a nonregulated waste. ABCOV™ is a demonstrated form of this process option.	The feasibility depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Removal of LAA-impacted ash is only feasible for small, select areas for reasons stated above under Removal, Transport, and Disposal GRA. Application of the process option to smaller (e.g., removable) volumes of forest fire ash is not feasible because implementation requires physical separation/segregation of LAA-impacted materials into similar materials and sizes, and removed ash materials would likely contain a mix of ash, partially combusted woody debris and duff, rocks, and soil.	No
			Chemical Digestion (In Situ)	Select areas of LAA-impacted ash would be treated using a spray-applied foam that soaks into porous materials and converts chrysotile asbestos contained within to an inert, non-fibrous form. Digestion Material for Asbestos (DMA®) is a commercial form of this process option.	Chemical digestion is not a technically implementable process option for application to the Phase 1 Area because the process option is only applicable to chrysotile asbestos-containing porous materials that can readily absorb the digestion agent, and the process option does not affect amphibole asbestos.	No
			Soil Washing (Ex Situ)	Contaminants sorbed onto fine particles are separated from bulk soil in an aqueous-based system on the basis of particle size. The wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics and heavy metals.	Removal and transport of LAA-impacted ash is only feasible for small, select areas. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted ash due to the need to treat the aqueous waste stream.	No
			Vitrification (In Situ)	An electrical current would be passed between electrodes inserted into LAA-impacted ash to cause melting. The melted matrix is then allowed to cool in place into a solid vitrified glass mass, thereby eliminating the inhalation route of exposure and reducing potential for LAA migration	Vitrification is not a technically implementable process option because it would require deep auger in-situ mixing of LAA-impacted ash with native materials prior to treatment which is not feasible as described above in the In Situ Mixing process option. The process option relies on the electrical conductivity of the materials making implementation difficult, and it requires a reliable source of electrical power which is not available at the Phase 1 Area so mobile generators would need to be used. The energy required is to overcome the resistance of the materials is high; therefore, vitrification is not considered an implementable process option.	No
			Electric Arc Vitrification (Ex Situ)	An electrical current would be passed between electrodes in a furnace creating an electrical arc. LAA-impacted ash placed in the furnace forms a molten bath that cools to form a vitrified glass mass. The vitrified glass mass is an inert waste.	Removal and transport of LAA-impacted ash is only feasible for small, select areas. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted ash because rocks would need to be removed and size reduction of larger materials would be required prior to treatment.	No
			Plasma Arc Vitrification (Ex Situ)	An electrical current would be passed between electrodes to form plasma. LAA-impacted ash placed in the plasma arc form a molten bath that cools to form a vitrified glass mass. The vitrified glass mass is an inert waste.	Removal and transport of LAA-impacted ash is only feasible for small, select areas. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted ash because rocks would need to be removed and size reduction of larger materials would be required prior to treatment.	No
		Thermal/ Chemical Treatment	Thermo-Caustic Dissolution (Ex Situ)	Select areas of LAA-impacted ash would be placed into a high temperature caustic (strong basic) solution. Asbestos fibers are partially to fully converted (changed to an amorphous structure) during immersion. Partially converted LAA is further converted using chemical reactions to form a viscous mixture, which is later vitrified. The resulting reaction product (glass) is an amorphous inert waste.	Removal and transport of LAA-impacted ash is only feasible for small, select areas. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted ash because rocks would need to be removed and size reduction of larger materials would be required prior to treatment.	No
			Thermo-Chemical Treatment (Ex Situ)	Select areas of LAA-impacted ash would be mixed with proprietary demineralizing agents within a hydrofluoric acid solution. The mixture is then heated in a rotary hearth furnace. This process is similar to vitrification but does not involve complete melting. Instead, the process results in partial sintering of the material. The resulting reaction product (rocklike material) is an inert waste. Thermo-chemical conversion technology (TCCT), patented by ARI Technologies Inc., is a commercial form of this process option.	Removal and transport of LAA-impacted ash is only feasible for small, select areas. This process option is not technically implementable for smaller quantities (e.g., removable, transportable volumes) of LAA-impacted ash because rocks would need to be removed and size reduction of larger materials would be required prior to treatment.	No

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Notes and Abbreviations:

ACD - Air Curtain Destructor	LAA - Libby Amphibole Asbestos
DMA - Digestion Material for Asbestos	NCP - National Oil and Hazardous Substances Pollution Contingency Plan
FMU3 - Fire Management Unit 3	OU3 - Operable Unit 3
GCL - geosynthetic clay liner	RI/FS - Remedial Investigation/Feasibility Study
ICs - Institutional Controls	TCCT - Thermo-chemical conversion technology

- (a) To mitigate risks of forest-fire ash to surface receptors, three phases were considered: 1) Before, 2) During, and 3) After a forest fire. The technologies listed under “During” and “After” should only be considered if a forest fire occurs within the OU3 Phase 1 Area. These options should be revisited based on the RI/FS results and the ability of remedies to limit risks.
- (b) It is important to note that recovery actions/remedy selection after a forest fire depends heavily on the amount of damage caused by the fire (i.e., severity of the fire) which can vary greatly depending on weather patterns during the fire and ignition source. As such, it is difficult to select remedial technologies for after a fire since extent and severity cannot be predicted. To remain conservative, some technologies were retained that would only apply to cases where the forest fire was small and of low severity. Additionally, options may be adjusted where LAA risks are low.
- (c) The screening evaluation of the process option implementability is preliminary because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).
- (d) For the purposes of this table the term *processed timber* refers to timber that has had all LAA-impacted bark, limbs and leaves removed and can be used for domestic or commercial use.

Table 4-1d
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LAA-impacted Bark^a
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General Response Action	Remedial Technology ^a	Process Option	Description of Option	Screening Comments ^b	Retained?
No Action	None	None	No action would be taken.	Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as baseline for comparison.	Yes
Institutional Controls (ICs)	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments (e.g., administrative and legal controls) that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Examples of legal controls that could be used for LAA-impacted bark are the same ones applicable to woodstove ash and may include: <ul style="list-style-type: none"> • Area closures and/or restrictions (e.g., restrictions on collection of wood in select areas within the Phase 1 Area) • Promote wood collection in forested areas outside of the Phase 1 Area or outside of specific areas within the Phase 1 Area • Restriction on use of woodstoves within the town of Libby • Offer easy access to inexpensive firewood not impacted by LAA 	Potentially implementable process option depending on type of IC and scope of application.	Yes
	Risk Communication Controls	Information and Education Programs/Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted bark. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted bark in specific areas, or for specific uses.	Potentially implementable process option.	Yes
Engineering Controls	Access and Use Management	Access and Use Management	The human health threat posed by burning LAA-impacted bark in woodstoves thus creating LAA-impacted woodstove ash would be reduced by restricting access to some wood sources in the Phase 1 Area. Access to portions of the Phase 1 Area would be limited by engineering controls which may include fences and warning signs to limit access by human receptors.	Potentially implementable process option depending on type and scope of engineering control.	Yes
Removal, Transport, Disposal	Removal	Logging and Processing (Forwarding, Skidding, Cable)	The human health threat posed by burning LAA-impacted bark in woodstoves thus creating LAA-impacted woodstove ash would be reduced through selective logging of areas within the Phase 1 Area (e.g., near the mine site or select areas within the proposed FS focus area). Whole-tree harvesting would be employed such that sources of fuel for use in woodstoves would be removed from portions of the Phase 1 Area. LAA-impacted timber from designated areas would be transported to a central processing area at the Phase 1 Area by forwarders (wheeled machines with an enclosed operator cab and log bunk), skidders (wheeled machine with a set of bottom-opening grapples used to grab, assemble and hold the logs), or cables (system of overhead cables, support towers, and winches to move whole tress of logs from the forest). The central processing area(s) would be used to process trees into products suitable for either household or commercial use (i.e., de-barking). For example, selective logging of trees was completed on the Grace property in the early 1990s which removed approximately 50% of the trees existing on the Grace property during active mining and processing activities. If another selective logging application were completed that targeted the larger, older trees, the number of trees that remain on the Grace property that existed on the property during active mining and processing activities could be significantly reduced along with any associated risks.	Potentially implementable process option for select areas. The extent of LAA-impacted timber and steep terrain would make it difficult to remove all potential sources.	Yes

Table 4-1d
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LAA-impacted Bark^a
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General Response Action	Remedial Technology ^a	Process Option	Description of Option	Screening Comments ^b	Retained?
Removal, Transport, Disposal (continued)	Transport of Slash	Mechanical Transport	LAA-impacted bark and limbs generated from processing the timber would be transported by logging trucks or other mechanical means to the Former Mine Area site for disposal.	Potentially implementable process option depending on scale of logging activities and ability to limit LAA transport during logging activities.	Yes
	Transport of Processed Timber ^c	Logging Trucks	Processed timber ^c (LAA-impacted bark and limbs removed) would be transported by log trucks outside of the OU3 Study Area for household or commercial use.	Potentially implementable process option depending on scale of logging activities and ability to limit LAA transport during processing activities.	Yes
	Disposal	Disposal of Slash (Former Mine Site)	LAA-impacted bark and limbs generated from processing the timber would be disposed at the Former Mine Area.	Potentially implementable process option. Size reduction of bark and limbs may need to be conducted at the processing area prior to disposal at the Former Mine Area. It is only implementable for removable and transportable quantities of slash.	Yes
		Disposal of Slash (Outside OU3 Study Area)	LAA-impacted bark and limbs generated from processing the timber would be consolidated and disposed of at a landfill that accepts friable asbestos waste (e.g., Class IV Landfill).	Disposal at a site outside of the OU3 Study Area is technically implementable because Class IV Landfills accept friable asbestos materials. It is only implementable for removable and transportable quantities of slash.	Yes
Containment	Surface Source and Migration Control	Surface Coating / Sealant	A surface coating or sealant would be spray applied to the bark of living trees in an effort to retain or adhere the LAA structures within the structure of the bark.	The areal and vertical extent of application significantly limits the implementability of this option. Surface coating for this application is not commercially available. Reapplication frequency is unknown. Surface coatings, not specific to this application, are generally made with petroleum hydrocarbons which would serve as an accelerant in the event of a forest fire. With respect to the woodstove ash scenario, surface coating would break down when burned and the exposure to woodstove ash would remain largely unaltered.	No
Treatment	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Slash Generated from Logging	An ACD would be used in conjunction with logging to condense and potentially treat the LAA-impacted bark, limbs, tops removed from the trees at the central processing area(s). The ACD firebox can be either a mobile above ground unit or an in-ground pit dug into the ground. The in-ground ACD design would include a pit dug into the ground with a transportable blower and curtain air plenum positioned to blow the curtain air over and down into pit.	Potentially implementable process option in select areas. The use of in-ground ACDs is common in applications such as destruction of forest-clearing debris because they are relatively light and can be towed into remote areas (Miller and Lemieux, 2007).	Yes
		Slash Pile Burn for Slash Generated from Logging	Slash pile burning would be used in conjunction with logging to condense the LAA-impacted bark, limbs, and tops removed from the trees at the central processing area(s).	Potentially implementable process option in select areas.	Yes

Notes and Abbreviations:

ACD - Air Curtain Destructor	LAA - Libby Amphibole Asbestos
CAG - Community Advisory Group	LUC - Land-Use Control
FS - Feasibility Study	NCP - National Oil and Hazardous Substances Pollution Contingency Plan
IC - Institutional Control	OU3 - Operable Unit 3

- (a) Technologies applicable to bark mitigate the woodstove ash risk. If left in place (e.g., the wood is not harvested), intact bark does not present unacceptable risk, so in-situ treatments for bark considered in this evaluation were limited to surface coating.
- (b) The screening evaluation of the process option implementability is preliminary because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).
- (c) For the purposes of this table the term *processed timber* refers to timber that has had all LAA-impacted bark, limbs and leaves removed and can be used for household or commercial use.

Table 4-2a
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
No Action	None	None	No action would be taken. Libby Amphibole Asbestos (LAA)-impacted duff would remain in its existing conditions.	1 There is no action to minimize exposures from the inhalation of LAA during disturbances of duff, or to minimize the migration of LAA-impacted duff. However, there is no increase in risk from current conditions if no action is taken and there are no environmental impacts. <u>Environmental Impacts:</u> None	1 Easily implemented technically but has low administrative feasibility.	0	\$	Retained	Required by National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as stand- alone alternative. Implementable and appropriate for areas with acceptable risk. ^c
Monitoring	Natural Recovery	Monitored Natural Recovery	The duff material is continually being both generated from falling branches, stems, leaves, needles, and pine cones, and decomposed into soil. The concentration of LAA in the materials contributing to the duff volume will diminish naturally over time since the primary source of LAA no longer exists (e.g., mining, milling and processing vermiculite). Eventually, non-impacted forest materials will fall and decompose on the forest floor. Ultimately, LAA fibers in the duff material will be buried by un-impacted duff material, which will then decompose becoming un-impacted soil. A monitoring program would be developed to evaluate the rate of decline of LAA fibers at established intervals (e.g., in advance of each Five Year Review) to track the progress of natural recovery.	2 The changes to exposure scenarios from the inhalation of LAA during disturbances of duff would be gradual. A reduction in the migration of LAA-impacted duff would also be gradual. There is no increase in risk from current conditions and impacts to human health and the environment during implementation (i.e., sampling) is low. <u>Environmental Impacts:</u> None	4 Easily implemented and can be applied to the entire Phase 1 Area and has moderate administrative and institutional feasibility.	\$\$	\$	Retained	Potentially viable process option.
Institutional Controls (ICs)	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments (administrative and legal controls) that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Some examples may include zoning restrictions, area closures and/or restrictions, building or excavation permits, well drilling prohibitions, easements, and covenants.	3 Protects human receptors through restriction of future uses of the Phase 1 Area that are not protective of human health and/or that could compromise the protectiveness of a remedy. Human receptors may choose to not comply with restrictions. Legal controls alone do not reduce the mobility, toxicity, or volume of LAA-impacted duff. <u>Environmental Impacts:</u> None	4 Implementable process option that can be applied to the entire Phase 1 Area and has relatively high administrative and institutional feasibility. There is the potential for public resistance.	\$\$	\$	Retained	Potentially viable process option.

Table 4-2a
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Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives	
							Capital Cost	O&M Cost			
ICs (continued)	Risk Communication Controls	Information and Education Programs/Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted duff. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted duff in specific areas, or for specific activities.	3	Protects human receptors through education and notification programs and implementation does not increase risk from the current conditions. Risk communication controls alone do not reduce the mobility, toxicity, or volume of LAA-impacted duff. <u>Environmental Impacts</u> : None	5	Easily implemented using available technical and community involvement labor sources.	\$	\$	Retained	Potentially viable process option.
Engineering Controls	Access and Use Management	Access and Use Management	Use of and access to areas with LAA-impacted duff would be managed by engineering controls (e.g., fencing and warning signs) to reduce exposure resulting from certain human activities.	4	Protects human receptors through signage (warnings), restricting access (e.g., fencing), and other means though human receptors may choose to ignore warnings, circumvent fencing, etc. Does not reduce the mobility, toxicity, or volume of LAA-impacted duff. <u>Environmental Impacts</u> : Fencing or other physical barriers providing access control could prevent animal access and/or migration into or out of the Phase 1 Area limiting their access to food sources and shelter. In the event of a fire in the Phase 1 Area, damage to wildlife may be increased due to inability to flee the area.	5	Easily implementable and can be applied to entire Phase 1 Area depending on scope and type of application. Resources readily available.	\$\$	\$	Retained	Potentially viable process option.
Containment	Surface Source Controls	Water Based Suppression	Select areas of LAA-impacted duff would be kept moist using water or a water-based dust suppressant to limit migration of LAA-impacted duff.	2	Wetting LAA-impacted duff for dust suppression inhibits LAA transport by air, but frequent wetting required to limit transport by air could facilitate LAA transport through surface water runoff. It may not be protective without other measures because it does not provide long-term effectiveness without continuous re-application and cannot be applied to all areas containing LAA-impacted duff. <u>Environmental Impacts</u> : The addition of water to the duff and soil will impact the natural infiltration rates, create a water imbalance with surrounding habitat, and the potential for an increase in surface water runoff that presents a flooding and erosion risk.	2	Access to water for suppression is limited by the rights to use and the availability of the water sources, and LAA impacts to water sources in the OU3 Study Area. Application would need to be coordinated with climatic conditions. Since continuous application would be necessary to remain effective, installation of an irrigation system in select areas would be likely. Installation of an irrigation system in the forested area presents challenges due to steep terrain and density of trees, so implementability would be limited to select areas.	\$\$	\$\$	Not retained due to implementability and increased LAA migration risk	Not viable as a long-term solution, and not retained because it is dependent upon the availability of water and has the potential to induce LAA migration through increases in surface water runoff and subsequent erosion.

Table 4-2a
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment (continued)	Surface Source Controls (continued)	Chemical Based Suppression	Select areas of LAA-impacted duff would be treated with a resinous or petroleum-based chemical dust suppressant (e.g., DusTreat™ DC9136) to limit migration of LAA-impacted duff. Chemical-based suppression is applied using equipment such as foamers, hydro-seeders or re-plumbed spraying trucks.	2 Chemical Based Suppression for LAA-impacted duff inhibits LAA transport by air; however, to provide long-term effectiveness frequent re-application would be required. It could not be applied to all areas containing LAA-impacted duff due to access restrictions on machinery used in application. Weather would also impact the effectiveness of the suppression. <u>Environmental Impacts:</u> Repeated application of a chemical dust suppressant has negative environmental impacts including, infiltration changes, interference with natural plant decay, covering/damaging animal homes, and plant respiration impacts. Additionally, a chemical based suppressant should be evaluated for potential fire accelerant properties and highly ignitable chemical-based suppressants should be excluded.	2 Implementable for select areas using available construction resources. Application to all areas containing LAA-impacted duff is not feasible due to access limitations for equipment used to spray dust suppressant. Implementation would result in negative ecological impacts.	\$\$\$	\$\$\$	Not retained due to implementability and environmental impacts	Not viable as a long-term solution, only applicable to select areas of LAA-impacted duff in the forested area, negative environmental impacts.
		In-Situ Mixing	Select areas of LAA-impacted duff would be mixed (e.g., using a cultivator or disk harrows) with underlying un-impacted soil or fill materials to limit migration of LAA-impacted duff.	1 In-situ mixing for LAA-impacted duff acts to mix duff into underlying soil to minimize surface exposure to, and migration of LAA-impacted duff. The efficacy of this treatment for duff at the Phase 1 Area is relatively low due to loosening of soils and root structures resulting in an increase in mobility and erosion and the possibility that underlying materials contain LAA at higher concentrations (i.e., the concept that underlying materials were exposed during active mining and thus are likely higher in LAA concentration). <u>Environmental Impacts:</u> Root systems would be damaged by the mixing, but since it is only implementable at such a small scale as discussed in the next column, the environmental impact would be minimal. The increased risk of erosion and migration could result in an impact to surface water receptors.	2 Implementable, but only for limited areas, and if it is limited to surface mixing. In-situ mixing is not implementable for the majority of the Phase 1 Area due to steep terrain, density of trees and roots, and areas of shallow bedrock. Also, if mixing with native materials, there would be a need to characterize the concentration profile prior to mixing to evaluate if mixing would bring materials with higher LAA concentrations to the surface. The use of in-situ mixing in a forested environment for the treatment of asbestos has not been previously demonstrated. Deep auger mixing is not considered technically implementable because even with clear cutting, remaining tree stumps and tree and plant roots would hinder the deeper mixing and likely damage the equipment.	\$\$\$	\$	Retained	Potentially viable process option. Due to limited information on its application in a forested environment, in-situ mixing is being retained pending additional information from the Forest Service despite the low effectiveness and implementability scores.

Table 4-2a
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^a		Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
								Capital Cost	O&M Cost		
Containment (continued)	Surface Source, Erosion and Migration Controls	Covers / Barriers: Soil or Rock	Select areas of LAA-impacted duff would be covered with a layer of clean soil or rock with sufficient thickness to reduce exposure risks to receptors and limit migration of LAA-impacted duff.	3	Protects human receptors through reducing surface exposure of LAA-impacted duff. Provides protection against LAA-impacted duff migration. A soil/rock cover would not prevent deposition of new duff that may be generated from LAA-impacted trees, potentially impacting the efficacy of the cover. Select tree removal prior to implementation would reduce future impacts (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> A soil or rock cover/barrier would alter infiltration rates, and cover and damage burrowing animal homes and plants; however, a soil or rock cover is only implementable at a very small scale as discussed in the next column, so the environmental impact would be minimal.	3	Implementable, but only for limited areas. Labor resources to implement would be available, but depends on the availability of materials.	\$\$\$\$	\$	Retained	Potentially viable process option for a limited area, and although effectiveness and implementability are lower as compared to a Vegetative Cover, it was retained to allow flexibility during design.
		Covers/Barriers: Asphalt or Concrete	Select areas of LAA-impacted duff would be covered with layers of asphalt or concrete with sufficient thickness to limit migration of LAA-impacted duff (shotcrete, poured, or rolled).	3	Protects human receptors through reducing surface exposure of LAA-impacted duff. Provides protection against LAA-impacted duff migration. A soil/rock cover would not prevent deposition of new duff that may be generated from LAA-impacted trees, potentially impacting the efficacy of the cover. Select tree removal prior to implementation would reduce future impacts (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> An asphalt or concrete cover/barrier would alter infiltration rates, and cover and damage burrowing animal homes and plants; however, an asphalt or concrete cover is only implementable at a very small scale as discussed in the next column, so the environmental impact would be minimal.	2	Implementable, but only for limited areas. Labor resources to implement would be available. The use of shotcrete would allow application to areas with steeper terrain; however, the overall implementability is considered low. Clear cutting prior to application would need to occur, and concrete applied to a forested area has a low administrative and institutional feasibility.	\$\$\$\$	\$	Implementability	Not viable as a solution due to low implementability.

Table 4-2a
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment (continued)	Surface Source, Erosion, and Migration Controls (continued)	Covers / Barriers: Vegetative	Select areas of LAA-impacted duff would be covered with a vegetative layer established by application of soil and/or soil amendments (e.g., compost, hydromulch, biochar) and seed mix (e.g., indigenous grasses and plants) by aerial or land application to limit migration of LAA-impacted duff.	4 Protects human receptors through reducing surface exposure of LAA-impacted duff. Provides protection against erosion and LAA migration. A vegetative cover would not prevent deposition of new duff that may be generated from LAA-impacted trees, potentially impacting the efficacy of the cover. Select tree removal prior to implementation would reduce future impacts (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> The erosion control provided is considered a positive environmental impact; however, the addition of an amendment placed in an ecosystem has the potential to disrupt natural processes. The use of indigenous plants and grasses is key to keeping the environmental impacts minimal.	4 Implementable for the majority of areas within the Phase 1 Area depending on the application method. Soil amendments can be distributed over duff by spraying, thus it could be applied to steep areas depending on access for the trucks. Aerial application significantly reduces the terrain and access challenges. If applied aerially, it is implementable for the majority of the Phase 1 Area, although areas with a dense canopy would limit consistent application to the duff, thus a combination of aerial and land application may be needed. The cover would need to be coordinated with the climatic conditions for proper plant establishment (e.g., do not install during rainy season or winter).	\$\$\$	\$	Retained	Potentially viable option.
		Slash Spreading (Barkley, 2015)	Tree limbs and branches can be spread on selected areas of duff and soil to reduce raindrop impact. If branches are cut small enough (slashed) so that they come in contact with the soil, they will also help disperse overland water flow and reduce runoff and erosion.	3 Protects human receptors through limiting migration of LAA-impacted duff through erosion control. Does not prevent mobilization of LAA-impacted duff to air. Spreading of slash generated from logging in or near the Phase 1 Area may impact efficacy due to presence of LAA within the bark. Spreading of tree branches and limbs may impact efficacy due to presence of LAA within the bark. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	3 Potentially implementable process option. If logging or vegetation management activities were performed at the Phase 1 Area, slash would be available. Slash from nearby un-impacted areas also could be used. The use of slash from the Phase 1 Area may have a low associated administrative and institutional feasibility.	\$	\$	Retained	Potentially viable option.
	Migration and Erosion Controls	Contour Log Terraces	Dead trees are felled, limbed, and placed on the contour perpendicular to the direction of the slope. Logs are placed in an alternating configuration so runoff is diverted and reduced in velocity, giving water time to percolate into the soil.	3 Protects human receptors through limiting migration of LAA-impacted duff through erosion control. Does not prevent mobilization of LAA-impacted duff to air. There are potential risks involved in felling dead trees from the Phase 1 Area. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4 Contour log terraces could be implemented using available construction resources. If dead trees from the Phase 1 Area containing LAA-impacted bark were used, source controls and health and safety controls would need to be utilized during the collection, felling, and de-limbing to protect workers and the environment. Logs should be 15 to 20 feet long and between 4 to 12 inches in diameter to be economically feasible. The implementability depends on the availability of suitable trees.	\$	\$	Retained	Potentially viable for mitigating LAA risks to surface water but does have potential risks involved in felling dead trees from the Phase 1 Area and potential lack of availability of suitable trees.

Table 4-2a
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^a		Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
								Capital Cost	O&M Cost		
Containment (continued)	Migration and Erosion Controls	Straw Wattles (Barkley, 2015)	Straw wattles are long tubes of plastic netting packed with excelsior, straw, or other material. Wattles are used in a similar fashion to log terraces. The wattle is flexible enough to bend to the contour of the slope.	4	Protects human receptors through limiting migration of LAA-impacted duff through erosion control. Does not prevent mobilization of LAA-impacted duff to air. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Straw wattles could be implemented using available construction resources. Straw wattles are available for purchase from erosion control companies. Installation of straw wattles is sometimes combined with trenching in steep areas. If soils are excavated during implementation and contain LAA they would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	\$	Retained	Potentially viable option for mitigating LAA risks to surface water.
		Straw Bale Check Dams (Barkley, 2015)	Straw bales placed in small drainages act as a dam collecting sediments from upslope and slowing the velocity of water traveling down the slope. Bales are placed in rows with overlapping joints.	4	Protects human receptors through limiting migration of LAA-impacted duff through erosion control. Does not prevent mobilization of LAA-impacted duff to air. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Straw bale check dams could be implemented using available construction resources. If straw bales are to be imbedded below the ground slightly, excavated soils are likely to contain LAA and would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	\$	Retained	Potentially viable option for mitigating LAA risks to surface water.
Removal, Transport, Disposal ^d	Removal	Pneumatic Removal (Vacuum Extraction/Pumping)	Select areas of LAA-impacted duff would be removed using vacuum hoses, vacuum trucks, or other pneumatic conveyance system.	4	Protects receptors by reducing future exposure to and the migration of LAA-impacted duff after implementation. Removal is only effective for select areas where removal of LAA-impacted duff is implementable as described in the next column. Select tree removal prior to duff removal would reduce future impacts if a single removal event was desired (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> Duff is an important component in the forest ecosystem (e.g. provides runoff and erosion control, nutrients input to soil, food for forest animals), thus removal without rehabilitation or vegetation replacement would have negative environmental impacts.	2	Pneumatic removal could be implemented using available construction resources; however, implementation would be difficult due to the heterogeneous nature of duff and other materials on the forest floor. Larger twigs, fallen branches, and plant materials on the forest floor would clog and damage the equipment.	\$\$\$\$\$	0	Not retained due to higher cost relative to mechanical removal and implementability	Not viable as a solution due to high cost and low implementability.

Table 4-2a
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Removal, Transport, Disposal ^d (continued)	Removal	Mechanical Removal (Excavation)	Select areas of LAA-impacted duff would be removed using mechanical excavation methods.	4 Protects receptors by reducing future exposure to and the migration of LAA-impacted duff after implementation; however, is only effective for select areas where removal of LAA-impacted duff is implementable as described in the next column. Select tree removal prior to duff removal would reduce future impacts if a single removal event was desired (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts</u> : Duff is an important component in the forest ecosystem (e.g. provides runoff and erosion control, nutrients input to soil, food for forest animals), thus removal without rehabilitation or vegetation replacement would have negative environmental impacts.	3 Mechanical Removal could be implemented using available construction resources. Duff removal may be combined with select tree removal to reduce future LAA--impacted duff generation and improve efficacy (see Tables 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). Removal must be combined with surface source controls during implementation to provide protection to workers and the environment. It is not implementable at a site-wide scale, but is for select areas.	\$\$\$\$	0	Retained	Potentially viable as a long-term solution for select areas; must be combined with transport and disposal technologies.
	Transport	Pneumatic Transport (Vacuum Extraction/Pumping)	Select areas of LAA-impacted duff would be transported using vacuum hoses, vacuum trucks, or other pneumatic conveyance system to disposal site.	3 Protects receptors by minimizing future exposure to and migration of LAA-impacted duff after implementation. Must be combined with removal and disposal technologies. <u>Environmental Impacts</u> : Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	2 Pneumatic Transport could be implemented if a portable vacuum truck was used. It can only be applied to locations in the Phase 1 Area where removal of duff by vacuum truck is feasible. Pneumatic removal of duff by vacuum truck and then subsequent transport by vacuum truck has low implementability due to removal difficulty related to the heterogeneity of the duff materials (e.g., larger twigs understory, and fallen branches could clog equipment). Must be combined with removal and disposal technologies.	\$\$\$\$\$	0	Higher cost relative to mechanical transport and Implementability	Not viable as a solution due to high cost and low implementability.
	Transport	Mechanical Transport (Hauling/Conveying)	Select areas of LAA-impacted duff would be transported by truck or other mechanical conveyance method for disposal at the Former Mine Area.	3 Protects receptors by minimizing future exposure to and migration of LAA-impacted duff after implementation. Must be combined with removal and disposal technologies. <u>Environmental Impacts</u> : Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3 Mechanical Transport could be implemented using available construction resources and is efficient for varying sizes of materials. It can only be applied to locations in the Phase 1 Area where removal of duff is feasible. Must be combined with removal and disposal technologies.	\$\$\$\$	0	Retained	Potentially viable as a long-term solution for select areas; must be combined with duff removal and disposal technologies.

Table 4-2a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Removal, Transport, Disposal ^d (continued)	Disposal	Disposal (Former Mine Area)	Select areas of LAA-impacted duff would be consolidated and disposed of at the Former Mine Area.	4 Protects receptors by reducing exposure to LAA-impacted duff at the original site location and provides containment with an engineered disposal facility. Must be combined with removal and transport technologies. <u>Environmental Impacts:</u> Disposal at the Former Mine Area would result in some short-term environmental impacts due to construction of the disposal cell.	3 Implementable using the Former Mine Area as the disposal location. Workers would be available to implement disposal and maintain the area; however, the administrative and institutional feasibility is moderate.	\$\$	\$\$	Retained	Potentially viable as a long-term solution for select areas where removal is feasible; must be combined with select tree removal and duff removal and transport technologies.
	Disposal	Disposal (Outside OU3 Study Area)	Select areas of LAA-impacted duff would be consolidated and disposed of at a location outside of the OU3 Study Area.	3 Protects receptors by reducing exposure to LAA-impacted duff at the original site location and provides containment with an engineered disposal facility. Must be combined with removal and transport technologies. It would only be effective for limited quantities due to implementability constraints described in the next column. <u>Environmental Impacts:</u> Disposal at a location outside of the OU3 Study Area would result in some short-term risk to the environmental during transportation to the off-site location (e.g., loss of containment during transport); however, the risk is considered temporary and minimal.	2 Implementability is considered low due to the volume limits of the facility and the potential for large disposal quantities, the need for properly containing waste during transport to limit migration to areas outside of the OU3 Study Area, and requirements to double bag and seal the waste with duct tape.	\$\$\$\$\$	0	Implementability and Cost	Not viable as a solution due to high cost and low implementability.
Treatment	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Consolidated Duff	An ACD would be used in select areas to condense and potentially treat the LAA-impacted duff material for disposal at the Former Mine Area. The ACD firebox can be either a mobile above ground unit or an in-ground pit dug into the ground. The in-ground ACD design would include a pit dug into the ground with a transportable blower and curtain air plenum positioned to blow the curtain air over and down into pit.	4 Protects receptors by consolidating the LAA-impacted duff for disposal. The variable temperature in the unit does not ensure thermal transformation of the LAA into a nonhazardous form (e.g., pyrolysis) but some transformation may occur. Must be combined with removal of duff. <u>Environmental Impacts:</u> The installation of an in-ground unit would result in minor disturbance of soils in the selected area, and the air emissions generated by the ACD should be evaluated.	3 Implementable since this design of ACD is common in applications such as destruction of forest-clearing debris. The use of in-ground ACDs is particularly common for destruction of forest-clearing debris because they are relatively light and can be towed into remote areas (Miller and Lemieux, 2007). It can only be applied to volumes of duff that are feasible to remove and consolidate. Condensed material would need to be covered in place or removed and disposed of.	\$\$	0	Retained	Potentially viable process option.

Table 4-2a
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Duff
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^a	Implementability ^b	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives	
							Capital Cost	O&M Cost			
Treatment (continued)	Treatment for Volume Reduction (continued)	Open Burning of Consolidated Duff	Duff associated with removal activities would be consolidated into piles and burned, similar to slash pile burning, to reduce volume and facilitate disposal.	3	Burning of duff would be effective at reducing the volume removed to facilitate disposal; however the potential impacts to human health and the environment during implementation may be unacceptable. <u>Environmental Impacts:</u> Habitat in the area where the open burning is conducted would be impacted, and the smoke generated may be disruptive to plants and animals during the burn.	2	Implementability is low due to the potential for restrictions on open burning; however it may be appropriate in certain circumstances when approval can be obtained. It can only be applied to volumes of duff that are feasible to remove and consolidate. Collection of condensed material for disposal would be difficult. Burning would need to be coordinated with site and climatic conditions (moisture, temperature, wind, etc.). Management and control of the fire and smoke would be required.	\$\$	0	Retained	Potentially viable process option and although effectiveness and implementability are lower as compared to use of an ACD it was retained since it may be appropriate and useful in certain circumstances.

Notes and Abbreviations:
ACD – Air Curtain Destructor
CAG – Community Advisory Group
IC – Institutional Control
LAA – Libby Amphibole Asbestos
LUC – Land Use Control
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
OU3 – Operable Unit 3
RMS – Risk Management Strategy

- (a) This table presents a preliminary evaluation of the process option effectiveness because it cannot be fully assessed without defining the performance criteria in an accepted Risk Management Strategy (RMS). Because many process options under consideration have potentially significant negative environmental impacts to the forest ecosystem and its related benefits, discussion of the environmental impact has been used to help evaluate the effectiveness of a process option in conjunction with the other evaluation criteria specified in the NCP.
- (b) This table presents a preliminary evaluation of the process option implementability because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).
- (c) The Risk Management Strategy may identify areas where unacceptable risks were not identified, but remedial actions may be considered as a conservative measure. In these areas, a No Action alternative may be appropriate.
- (a) The efficacy of Removal, Transport, and Disposal of duff in the forested area is dependent upon the removal of trees, so costs and feasibility of logging in the Phase 1 Area should also be considered for this General Response Action. For feasibility, implementability and relative cost of logging in the Phase 1 Area refer to **Tables 4-1d** and **4-2d**. The negative environmental impacts of tree removal also must be considered and weighed against the potential for a reduction in risk.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
No Action	None	None	No action would be taken. Libby Amphibole Asbestos (LAA)-impacted forest soil would remain in their existing conditions.	1 There is no action to minimize exposures from the inhalation of LAA during disturbances of forest soil, or to minimize the migration of LAA from forest soil to other media. However, there is no increase in risk from current conditions if no action is taken and there are no environmental impacts. <u>Environmental Impacts:</u> None	1 Easily implemented technically but has low administrative feasibility.	0	\$	Retained	Required by National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as stand- alone alternative. Implementable and appropriate for areas with acceptable risk. ^d
Monitoring	Natural Recovery	Monitored Natural Recovery	Forested areas where soil is covered by duff and is continually being covered from falling branches, stems, leaves, needles, and pine cones, which are decomposed into soil. The concentration of LAA in the materials contributing to the soil will diminish naturally over time since the primary source of LAA no longer exists (e.g., mining, milling and processing vermiculite). Eventually, non-impacted forest materials will fall and decompose on the forest floor. Ultimately, LAA fibers in the forest soil will be buried by un-impacted duff material, which will then decompose becoming un-impacted soil. A monitoring program would be developed to evaluate the rate of decline of LAA fibers at established intervals (e.g., in advance of each Five Year Review) to track the progress of natural recovery.	2 The changes to exposures scenarios from the inhalation of LAA during disturbances of forest soil would be gradual. A reduction in the migration of LAA-impacted forest soil would also be gradual. There is no increase in risk from current conditions and impacts to human health and the environment during implementation (i.e., sampling) is low. <u>Environmental Impacts:</u> None	4 Easily implemented and can be applied to the entire Phase 1 Area and has moderate administrative and institutional feasibility.	\$\$	\$	Retained	Potentially viable process option.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives	
							Capital Cost	O&M Cost			
Institutional Controls (ICs)	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Some examples may include zoning restrictions, area closures and/or restrictions, building or excavation permits, well drilling prohibitions, easements, and covenants.	3	Protects human receptors through restriction of future uses of the Phase 1 Area that are not protective of human health and/or that could compromise the protectiveness of a remedy. Human receptors may choose to not comply with restrictions. Legal controls alone do not reduce the mobility, toxicity, or volume of LAA-impacted forest soil. <u>Environmental Impacts:</u> None	4	Implementable process option that can be applied to the entire Phase 1 Area and has relatively high administrative and institutional feasibility. There is the potential for public resistance.	\$\$	\$	Retained	Potentially viable process option.
	Risk Communication Controls	Information and Education Programs/ Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted forest soil. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted forest soil in specific areas, or for specific activities.	3	Protects human receptors through education and notification programs and implementation does not increase risk from the current conditions and there is no associated environmental impacts. Risk Communication Controls alone do not reduce the mobility, toxicity, or volume of LAA-impacted forest soil. <u>Environmental Impacts:</u> None	5	Easily implemented using available technical and community involvement labor sources.	\$	\$	Retained	Potentially viable process option.
Engineering Controls	Access and Use Management	Access and Use Management	Use of and access to select areas with LAA-impacted forest soil would be managed by engineering controls (e.g., fencing and warning signs) to reduce exposure resulting from certain human activities.	4	Protects human receptors through warnings and restricted access through fencing though human receptors may ignore warnings and circumvent fencing. Does not reduce the mobility, toxicity, or volume of LAA-impacted forest soil. <u>Environmental Impacts:</u> Fencing or other physical barriers providing access control could prevent animal access and/or migration into or out of the Phase 1 Area limiting their access to food sources and shelter. In the event of a fire in the Phase 1 Area, damage to wildlife may be increased due to inability to flee the area.	5	Potentially implementable process option depending on scope and type of application. Resources readily available.	\$\$	\$	Retained	Potentially viable process option.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment	Surface Source Controls	Water Based Suppression	Select areas of LAA-impacted forest soil would be kept moist using water or a water-based dust suppressant to control migration of LAA-impacted forest soil.	2 Wetting LAA-impacted forest soil for dust suppression inhibits LAA transport by air, but frequent wetting required to control transport by air could facilitate LAA transport through surface water runoff. Protectiveness is limited without other measures because it does not provide long-term effectiveness without continuous re-application and cannot be applied to all areas containing LAA-impacted forest soil. <u>Environmental Impacts:</u> The addition of water to the duff and forest soil will impact the natural infiltration rates, create a water imbalance with surrounding habitat, and the potential for an increase in surface water runoff presents an erosion risk and risk to surface waters.	2 Access to water for suppression is limited by rights to use and the availability of the water sources, and LAA impacts to water sources at the OU3 Study Area. Application would need to be coordinated with climatic conditions. Since continuous application would be necessary to remain effective, installation of an irrigation system in select areas would be likely. Installation of an irrigation system in the forested area presents challenges due to steep terrain and density of trees, so implementability would be limited to select areas.	\$\$	\$\$	Not retained due to implementability and increased LAA migration risk	Not viable as a long-term solution, and not retained because it is dependent upon the availability of water and has the potential to induce LAA migration through increases in surface water runoff and subsequent erosion.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment (continued)	Surface Source Controls (continued)	Chemical Based Suppression	Select areas of LAA-impacted forest soil would be treated with a resinous or petroleum-based chemical dust suppressant (e.g., DusTreat™ DC9136) to limit migration of LAA-impacted soil. Chemical-based suppression is applied using equipment such as foamers, hydro-seeders or re-plumbed spraying trucks.	2 Chemical Based Suppression for LAA-impacted forest soil inhibits LAA transport by air; however, to provide long-term effectiveness frequent re-application would be required. It could not be applied to all areas containing LAA-impacted soil due to access restrictions on machinery used in application. Weather (e.g., rain, snow) would also impact the effectiveness of the suppression. <u>Environmental Impacts:</u> Repeated application of a chemical dust suppressant has negative environmental impacts including, infiltration changes, interference with natural plant decay, covering/damaging animal homes, and plant respiration impacts. Additionally, a chemical based suppressant should be evaluated for potential fire accelerant properties and highly ignitable chemical-based suppressants should be excluded.	2 Implementable for select areas using available construction resources. Application to all areas containing LAA-impacted forest soil is not feasible due to access limitations for equipment used to spray dust suppressant. Application would need to be coordinated with climatic conditions.	\$\$\$	\$\$\$	Not retained due to implementability, and environmental impacts	Not viable as a long-term solution, only applicable to select areas of LAA-impacted soil in the forested area, and negative environmental impacts.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment (continued)	Surface Source Controls	In-Situ Mixing	Select areas of LAA-impacted forest soil would be mixed (e.g., using a cultivator or disk harrows) with underlying un-impacted soil or fill materials to limit migration of LAA-impacted forest soil.	1 In-situ mixing for LAA-impacted forest soil acts to mix surface soil into underlying soil to minimize surface exposure to, and migration of LAA-impacted soil. The efficacy of this treatment for soil at the Phase 1 Area is relatively low due to loosening of soils and root structures resulting in an increase in mobility and erosion and the possibility that underlying materials contain LAA at higher concentrations (i.e., the concept that underlying materials were exposed during active mining and thus are likely higher in LAA concentration). <u>Environmental Impacts:</u> Root systems would be damaged by the mixing, but since it is only implementable at such a small scale as discussed in the next column, the environmental impact would be minimal. The increased risk of erosion and migration could result in an impact to surface water receptors.	2 Implementable, but only for limited areas, and if it is limited to surface mixing. In-situ mixing is not implementable for the majority of the Phase 1 Area due to steep terrain, density of trees and roots, and areas of shallow bedrock. Also, if mixing with native materials, there would be a need to characterize the concentration profile prior to mixing to evaluate if mixing would bring materials with higher LAA concentrations to the surface. The use of in-situ mixing in a forested environment for the treatment of asbestos has not been previously demonstrated. Deep auger mixing is not considered technically implementable because even with clear cutting, remaining tree stumps and tree and plant roots would hinder the deeper mixing and likely damage the equipment.	\$\$\$	\$	Retained	Potentially viable process option. Due to limited information on its application in a forested environment, in-situ mixing is being retained pending additional information from the Forest Service despite the low effectiveness and implementability scores.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment (continued)	Surface Source, Erosion, and Migration Control	Covers / Barriers: Soil or Rock	Select areas of LAA-impacted forest soil would be covered with a layer of clean soil or rock with sufficient thickness to reduce exposure risks to receptors and limit migration of LAA-impacted forest soil.	3 Protects human receptors through reducing surface exposure of LAA-impacted forest soil. Provides protection against LAA-impacted soil migration by air and surface water runoff. A soil/rock cover would not prevent deposition of new duff that may be generated from LAA-impacted trees, potentially impacting the efficacy of the cover. Select tree removal prior to implementation would reduce future impacts (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). It would be susceptible to animal disturbance that may also impact its efficacy. <u>Environmental Impacts:</u> A soil or rock cover/barrier would alter infiltration rates and cover and damage burrowing animal homes and plants that are key to the forest ecosystem; however, a soil or rock cover is only implementable at a very small scale as discussed in the next column, so the environmental impact would be minimal.	3 Implementable, but only for limited areas. Labor resources to implement would be available, but depends on the availability of materials.	\$\$\$\$	\$	Retained	Potentially viable process option for a limited area, and although effectiveness and implementability are lower as compared to a Vegetative Cover, it was retained to allow flexibility during design.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment	Surface Source, Erosion, and Migration Control	Asphalt or Concrete	Select areas of LAA-impacted forest soil would be covered with layers of asphalt or concrete with sufficient thickness to limit migration of LAA-impacted soil (shotcrete, poured, or rolled).	3 Protects human receptors through reducing surface exposure of LAA-impacted soil. Provides protection against LAA-impacted soil migration. A soil/rock cover would not prevent deposition of new duff that may be generated from LAA-impacted trees, potentially impacting the efficacy of the cover. Select tree removal prior to implementation would reduce future impacts (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> An asphalt or concrete cover/barrier would alter infiltration rates and cover and damage burrowing animal homes and plants that are key to the forest ecosystem; however, an asphalt or concrete cover is only implementable at a very small scale as discussed in the next column, so the environmental impact would be minimal.	2 Implementable, but only for limited areas. Labor resources to implement would be available. The use of shotcrete would allow application to areas with steeper terrain; however, the overall implementability is considered low. Clear cutting prior to application would need to occur, and concrete applied to a forested area has a low administrative and institutional feasibility.	\$\$\$\$	\$	Implementability	Not viable as a solution due to low implementability.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Containment (continued)	Surface Source, Erosion, and Migration Control (continued)	Covers / Barriers: Vegetative	Select areas of LAA-impacted forest soil would be covered with a vegetative layer established by application of soil and/or soil amendments (e.g., compost, hydromulch, biochar) and seed mix (e.g., indigenous plants and grasses) by aerial or land application to limit migration of LAA-impacted soil.	4 Protects human receptors through minimizing surface exposure of LAA-impacted forest soil. Provides protection against erosion and LAA transport by air and surface water runoff. A vegetative cover would not prevent deposition of new duff that may be generated from LAA-impacted trees. Select tree removal prior to implementation would reduce future impacts (see Table 4-1d and Table 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> The erosion control provided is considered a positive environmental impact; however, the addition of an amendment placed in an ecosystem has the potential to disrupt natural processes. The use of indigenous plants and grasses is key to keeping the environmental impacts minimal.	4 Implementable for most areas within the Phase 1 Study Area depending on the application method. Soil amendments can be distributed over soil by spraying, thus it could be applied to steep areas depending on access for the trucks. Aerial application significantly reduces the terrain and access challenges. If applied aerially, it is implementable for much of the Phase 1 Area, although areas with a dense canopy would limit consistent application to the soil, thus a combination of land and aerial application may be needed. The cover would need to be applied to overlaying duff as well, unless duff removal was conducted prior to implementation. Also the cover would need to be coordinated with the climatic conditions for proper plant establishment (e.g., do not install in rainy season or winter).	\$\$\$	\$\$	Retained	Potentially viable option.
		Slash Spreading	Tree limbs and branches can be spread on the forest soil to reduce raindrop impact. If branches are cut small enough (slashed) so that they come in contact with the soil, they will also help disperse overland water flow and reduce runoff and erosion.	3 Protects human receptors through limiting migration of LAA-impacted forest soil through erosion control. Does not prevent mobilization of LAA-impacted soil to air. Spreading of slash generated from logging in or near the Phase 1 Area may impact efficacy due to presence of LAA within the bark. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	3 Potentially implementable process option in select areas. If logging or vegetation management activities were performed at the Phase 1 Area, slash would be available. Slash from nearby un-impacted areas also could be used. The use of slash from the Phase 1 Area may have a low associated administrative and institutional feasibility.	\$\$	\$	Retained	Potentially viable option.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^b		Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
								Capital Cost	O&M Cost		
Containment (continued)	Migration and Erosion Control	Contour Log Terraces	Dead trees are felled, limbed, and placed on the contour perpendicular to the direction of the slope. Logs are placed in an alternating configuration so runoff is diverted and reduced in velocity and giving water time to percolate into the forest soil.	4	Protects human receptors through limiting migration of LAA-impacted forest soil through erosion control. Does not prevent mobilization of LAA-impacted forest soil to air. There are potential risks involved in felling dead trees from the Phase 1 Area. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Contour log terraces could be implemented using available construction resources. If dead trees containing LAA-impacted bark were used, source controls and health and safety controls would need to be utilized during the collection, felling, and de-limbing to protect workers and the environment. Logs should be 15 to 20 feet long and between 4 to 12 inches in diameter to be economically feasible. The implementability depends on the availability of suitable trees.	\$\$	\$	Retained	Potentially viable for mitigating LAA risks to surface water but does have potential risks involved in felling dead trees from the Phase 1 Area and potential lack of availability of suitable trees.
		Straw Wattles	Straw wattles are long tubes of plastic netting packed with excelsior, straw, or other material. Wattles are used in a similar fashion to log terraces. The wattle is flexible enough to bend to the contour of the slope.	4	Protects human receptors through limiting migration of LAA-impacted forest soil through erosion control. Does not prevent mobilization of LAA-impacted soil to air. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Straw wattles could be implemented in select areas using available construction resources. Straw wattles are available for purchase from erosion control companies. Installation of straw wattles is sometimes combined with trenching in steep areas. If soils are excavated during implementation and contain LAA they would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	\$	Retained	Potentially viable option for mitigating LAA risks to surface water.
		Straw Bale Check Dams	Straw bales placed in small drainages act as a dam collecting sediments from upslope and slowing the velocity of water traveling down the slope. Bales are placed in rows with overlapping joints.	4	Protects human receptors through limiting migration of LAA-impacted forest soil through erosion control. Does not prevent mobilization of LAA-impacted soil to air. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Straw bale check dams could be implemented using available construction resources. If straw bales are to be imbedded below the ground slightly, excavated soils are likely to contain LAA and would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	\$	Retained	Potentially viable option for mitigating LAA risks to surface water.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Removal, Transport, Disposal ^e	Removal	Pneumatic Removal (Vacuum Extraction / Pumping)	Select areas of LAA-impacted soil would be removed using vacuum hoses, vacuum trucks, or other pneumatic conveyance system.	4 Protects receptors by reducing future exposure to and the migration of LAA-impacted soil after implementation. Removal is only effective for select areas where removal of LAA-impacted soil and duff is implementable as described in the next column. A single removal event may not be sufficient due to deposition of limited new duff that may be generated from LAA-impacted trees. Select tree removal prior to duff and soil removal would reduce future impacts if a single removal event was desired (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> Soil is an important component in the forest ecosystem. Removal of soil could harm burrowing animals during removal efforts, remove future habitats, cause instability, possible erosion, and would remove plants and nutrients along with the soil that are vital to forest ecology.	2 Pneumatic removal could be implemented using available construction resources; however, implementation would be difficult due to the need to remove understory and duff to access the soils underneath. Areas of rocky soil would make hinder pneumatic removal and potentially clog and damage the equipment.	\$\$\$\$\$	0	Not retained due to higher cost relative to mechanical removal and implementability	Not viable as a solution due to high cost and low implementability.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-impacted Forest Soil^a
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General Response Action	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Removal, Transport, Disposal ^e (continued)	Removal	Mechanical Removal (Excavation)	Select areas of LAA-impacted forest soil would be removed using mechanical excavation methods.	4 Protects receptors by minimizing future exposure to LAA-impacted forest soil and migration of LAA after implementation. Removal is only effective for select areas where removal of LAA-impacted soil and duff is implementable as described in the next column. A single removal event may not be sufficient due to deposition of new duff that may be generated from LAA-impacted trees. Select tree removal prior to soil removal would reduce future impacts if a single removal event was desired (See Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> Soil is an important component in the forest ecosystem. Removal of soil could harm burrowing animals during removal efforts, remove future habitats, cause instability, possible erosion, and would remove plants and nutrients along with the soil that are vital to forest ecology.	2 Mechanical Removal could be implemented using available construction resources. Soil removal could be combined with duff removal and possible limited tree removal to minimize future impacts to soil from LAA-impacted duff generation and improve efficacy (see Tables 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). Removal must be combined with surface source controls during implementation to provide protection to workers and the environment. It is not implementable at a site-wide scale, but is for select areas.	\$\$\$\$	0	Retained	Potentially viable as a long-term solution for select areas; must be combined with duff removal and transport and disposal technologies.

Table 4-2b
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
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General Response Action	Remedial Technology	Process Option	Description of Option		Effectiveness ^b		Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
								Capital Cost	O&M Cost		
Removal, Transport, Disposal ^e (continued)	Transport	Pneumatic Transport (Vacuum Extraction/Pumping)	Select areas of LAA-impacted forest soil would be transported using vacuum hoses, vacuum trucks, or other pneumatic conveyance system to disposal site.	3	Protects receptors by minimizing future exposure to and migration of LAA-impacted soil after implementation. Must be combined with removal and disposal technologies. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	2	Pneumatic Transport could be implemented if a portable vacuum truck was used. It can only be applied to locations in the Phase 1 Area where removal of soil by vacuum truck is feasible. Must be combined with removal and disposal technologies. Pneumatic removal of soil and subsequent transport by vacuum truck has low implementability due to removal limitations described above under pneumatic removal.	\$\$\$\$\$	0	Higher cost relative to mechanical transport and Implementability	Not viable as a solution due to high cost and low implementability.
		Mechanical Transport (Hauling/Conveying)	Select amounts of LAA-impacted soil would be transported by truck or other mechanical conveyance method for disposal at the Former Mine Area.	3	Protects receptors by minimizing future exposure to and migration of LAA-impacted soil after implementation. Must be combined with removal and disposal technologies. A single removal event may not be sufficient due to deposition of new duff that may be generated from LAA-impacted trees. Select tree removal prior to soil removal would reduce future impacts if a single removal event was desired (see Table 4-1d and 4-2d for descriptions on logging methodology and feasibility for the Phase 1 Area). <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3	Mechanical Transport could be implemented using available construction resources and is efficient for various sizes of materials. It can only be applied to locations in the Phase 1 Area where removal of duff and soil is feasible. Must be combined with removal and disposal technologies.	\$\$\$\$	0	Retained	Potentially viable as a long-term solution for select areas; must be combined duff and soil removal and disposal technologies.

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						Capital Cost	O&M Cost		
Removal, Transport, Disposal ^e (continued)	Disposal	Disposal (Former Mine Area)	Select amounts of LAA-impacted soil would be consolidated and disposed of at the Former Mine Area.	4 Protects receptors by minimizing exposure to LAA-impacted soil at the original site location and provides containment with an engineered disposal facility. Must be combined with removal and transport technologies. <u>Environmental Impacts:</u> Disposal at the Former Mine Area would result in some short-term environmental impacts due to construction of the disposal cell.	3 Implementable using the Former Mine Area as the disposal location. Workers would be available to implement disposal and maintain the area; however, the administrative and institutional feasibility is moderate.	\$\$	\$\$	Retained	Potentially viable as a long-term solution for select areas where removal is feasible; must be combined with duff and/or soil removal and transport technologies.
		Disposal (Outside OU3 Study Area)	Select areas of LAA-impacted soil would be consolidated and disposed of at a location outside of the OU3 Study Area.	3 Protects receptors by reducing exposure to LAA-impacted soil at the original site location and provides containment with an engineered disposal facility. Must be combined with removal and transport technologies. It would only be effective for limited quantities due to implementability constraints described in the next column. <u>Environmental Impacts:</u> Disposal at a location outside of the OU3 Study Area would result in some short-term risk to the environmental during transportation to the off-site location (e.g., loss of containment during transport); however, the risk is considered temporary and minimal.	2 Implementability is considered low due to the volume limits of the facility and the potential for large disposal quantities, the need for properly containing waste during transport to limit migration to areas outside of the OU3 Study Area, and requirements to double bag and seal the waste with duct tape.	\$\$\$\$\$	0	Implementability and Cost	Not viable as a solution due to high cost and low implementability.

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Notes and Abbreviations:

- CAG – Community Advisory Group
- IC – Institutional Control
- LAA – Libby Amphibole Asbestos
- LUC – Land Use Control
- NCP – National Oil and Hazardous Substances Pollution Contingency Plan
- OU3 – Operable Unit 3
- RMS – Risk Management Strategy

- (a) Soil along creeks and within drainages will be managed in the Phase II Feasibility Study.
- (b) This table presents a preliminary evaluation of the process option effectiveness because it cannot be fully assessed without defining the performance criteria in an accepted Risk Management Strategy (RMS). Because many process options under consideration have potentially significant negative environmental impacts to the forest ecosystem and its related benefits, discussion of the environmental impact has been used to help evaluate the effectiveness of a process option in conjunction with the other evaluation criteria specified in the NCP.
- (c) This table presents a preliminary evaluation of the process option implementability because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).
- (d) The Risk Management Strategy may identify areas where unacceptable risks were not identified, but remedial actions may be considered as a conservative measure. In these areas, a No Action alternative may be appropriate.
- (e) The efficacy of Removal, Transport, and Disposal of soil in the forested area is dependent upon the removal of trees, so costs and feasibility of logging in the Phase 1 Area should also be considered for this GRA. For feasibility, implementability and relative cost of logging the Phase 1 Area, refer to **Tables 4-1d** and **4-2d**. The environmental impacts of tree removal also must be considered and weighed against the potential for a reduction in risk.

Table 4-2c
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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option		Effectiveness ^c		Implementability ^d	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
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<u>Before</u> , <u>During</u> , and <u>After</u> a Forest Fire	No Action	None	None	No action would be taken.	1	There is no action to minimize exposures from the inhalation of Libby Amphibole Asbestos (LAA)-impacted forest fire ash, or to minimize the migration of LAA. However, there is no increase in risk from current conditions if no action is taken. <u>Environmental Impacts:</u> None	1	Easily implemented technically but has low administrative feasibility.	0	\$	Retained	Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as stand-alone alternative. Implementable and appropriate for areas with acceptable risk. ^e
	Institutional Controls	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Some examples applicable to forest-fire ash include implementing measures to reduce the chance of a forest fire occurring and measures to protect human receptors during and after a fire. Specifically legal/administrative controls for forest fire LAA-impacted ash may include but are not limited to: <ul style="list-style-type: none">- Restrictions on smoking and camp fires on or around the Phase 1 Area- Area closures and/or restrictions- Restrictions on building and maintenance of utility lines that run through or near the Phase 1 Area- Restrictions on storage of flammable liquids- Temporary relocation of residents during a forest fire based on air monitoring action levels (e.g., mandatory evacuation)- Specific emergency response plan/fire management plan for the OU3 Study Area to protect firefighters (already exists)- Access and zoning restrictions after a fire.	3	Restricts future uses of the Phase 1 Area that are not protective of human health or that could compromise the protectiveness of a remedy. Legal Controls would not remove the source of the forest fire ash, but would prevent access to it. It would not prevent LAA-impacted forest fire ash from being mobilized off the Phase 1 Area by surface water runoff after a forest fire. <u>Environmental Impacts:</u> None	4	Implementable process option that can be applied to the entire Phase 1 Area and has relatively high administrative and institutional feasibility. There is the potential for public resistance.	\$\$	\$	Retained	Potentially viable process option.

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									Capital Cost	O&M Cost		
<u>Before</u> and <u>After</u> a Forest Fire	Institutional Controls	Risk Communication Controls	Information and Education Programs/ Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted ash. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted ash in specific areas, or for specific activities.	3	Protects human receptors through education and notification programs and implementation does not increase risk from the current conditions and there is no associated environmental impacts. Risk Communication Controls alone do not reduce the mobility, toxicity, or volume of LAA-impacted ash. <u>Environmental Impacts:</u> None	5	Easily implemented using available technical and community involvement labor sources.	\$	\$	Retained	Potentially viable process option.
	Engineered Controls	Access and Use Management	Access and Use Management	Use of and access to select areas with LAA impacts would be managed by engineering controls (e.g., fencing and warning signs) to reduce forest fire risks posed by certain human activities. Engineering controls could be used to prevent human receptors for using the area for camping or other recreational activities that may increase the risk of forest fire. No smoking and campfire restriction signs in select areas in or near the Phase 1 Area would be another form of engineered control to reduce risk of fire. Fencing and posted warning signs could also be used after a forest fire around the extent of ash impacts to prevent exposure to human receptors.	4	Fire prevention through restrictions on camping and recreation and fencing reduces the risk of a fire. Access controls after a fire would protect human receptors by preventing direct exposure to forest fire ash, though human receptors may choose to ignore warnings and circumvent fencing. Does not eliminate the source of the forest fire ash, but would prevent access to it. <u>Environmental Impacts:</u> Fencing or other physical barriers providing access control could prevent animal access and/or migration into or out of the Phase 1 Area limiting their access to food sources and shelter. In the event of a fire in the Phase 1 Area, damage to wildlife may be increased due to inability to flee the area.	5	Implementable in select areas. Resources for construction of engineering controls are readily available.	\$\$	\$	Retained	Potentially viable process option.
	Engineering Controls	Forest and Fire Management	Vegetation Management	Fire prevention and vegetation management activities (e.g., removal of dead and dying underbrush, development and/or maintenance of firebreaks, controlled burns) would be conducted to limit the LAA-impacted forest fire ash. Post-fire activities to limit ash migration and exposure would be specific to each fire and based on standard federal guidelines. Migration and erosion control for ash are discussed below under the section containing process options specific to conditions after a forest fire.	4	Fire prevention can prevent fires from occurring or reduce their severity when they do occur minimizing the risk of LAA-impacted forest fire ash generation. Fire management activities after a fire would limit migration of ash resulting in reduced exposure. <u>Environmental Impacts:</u> Wildfires can destroy and devastate forest ecosystems, thus fire prevention and management activities are considered positive actions for the forest ecology. Although considered overall positive, vegetation management and the development of firebreaks does cause temporary disturbances to the ecosystem and removal of limited amounts of habitat.	4	Implementable in select areas. Resources for construction of engineering controls are readily available.	\$\$	\$	Retained	Potentially viable process option.

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<u>Before</u> a Forest Fire	Removal, Transport, Disposal	Removal	Logging (Forwarding, Skidding, Cable) (Anderson et al, 2012)	Targeted logging could be used to limit LAA-impacted bark in the Phase 1 Area. Whole-tree harvesting would be employed such that a potential source of LAA-impacted forest-fire ash would be minimized at the Phase 1 Area (e.g., areas within the Grace proposed Feasibility Study (FS) focus area). LAA-impacted timber would be transported to a central processing area at the Phase 1 Area by forwarders (wheeled machines with an enclosed operator cab and log bunk), skidders (wheeled machine with a set of bottom-opening grapples used to grab, assemble and hold the logs), or cables (system of overhead cables, support towers, and winches to move whole tress of logs from the forest). The central processing area(s) would be used to process trees into products suitable for either household or commercial use (i.e., de-barking). For example, selective logging of trees was completed on the Grace property in the early 1990s which removed approximately 50% of the trees that were present on the Grace property during active mining and processing activities. If another selective logging application were completed that targeted the larger, older trees, the number of trees that remain on the Grace property that existed during active mining and processing activities could be significantly reduced along with any associated risks.	3	Protects receptors by minimizing a potential source of forest fire ash. Effective for areas where logging is feasible. Must be combined with transport and disposal technologies. Erosion controls after logging activities would be required to prevent LAA-impacted soil and duff mobilization. Since other sources of forest fire ash (e.g., duff, understory) would remain, the process option should be combined with fire management and prevention strategies. <u>Environmental Impacts:</u> The environmental and erosion impacts of whole tree harvesting for all forested areas within the Phase 1 Area would be significant and widespread if undertaken on a large scale (e.g., topsoil loss, loss of habitat for all species, removal of trees which absorb a major greenhouse gas [CO ₂]). Large-scale deforestation would result in a loss of habitat for all species within the Phase 1 Area. Removal of trees would slow the natural recovery process where LAA-impacted duff and soil eventually become covered by un-impacted duff (see Monitored Natural Recovery in Tables 4-1a and 4-1b). Select tree removal may be desirable from a forest management perspective and if done in phases, the environmental impact would be reduced. Despite the challenges of logging in the Phase 1 Area and the environmental impacts discussed below, if a combination of logging techniques were applied to counteract terrain and access issues, logging activities were limited, and health and safety controls were put in place to protect loggers from LAA exposure, this method is a potentially feasible option for select areas of high LAA-impacted bark to minimize the risk associated with forest-fire ash. Since other sources of forest fire ash (duff, understory) would remain, the process option could be combined with fire management and prevention strategies.	3	Implementable in select areas using available logging resources. The extent of LAA-impacted timber and steep terrain would make it difficult to remove all potential sources. At the central processing area(s), LAA-impacted bark and limbs would need to be removed prior to transport off of the OU3 Study Area for household or commercial use. . A testing program would be established for the processed logs to provide assurances for proper handling and end-use of materials. May need to be combined with fire management and prevention strategies.	\$\$\$\$	0	Retained	Potentially viable process option.
		Transport of Slash	Mechanical Transport	LAA-impacted bark and limbs generated from processing the timber would be transported by log trucks or other mechanical means to the Former Mine Area for disposal.	3	Protects receptors by minimizing future exposure to LAA-impacted bark and limbs after implementation. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3	Implementable using available construction resources. Health and safety controls, and source controls would need to be utilized during implementation to provide protection to workers and the environment.	\$\$\$\$	0	Retained	Potentially viable process option.

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<u>Before</u> a Forest Fire (continued)	Removal, Transport, Disposal (continued)	Transport of Processed Timber ^f	Logging Trucks	Processed timber ^f (LAA-impacted bark and limbs removed) would be transported by log trucks off the OU3 Study Area for household or commercial use.	4	Protects receptors by minimizing the source of forest fire ash, and providing a source of timber for commercial or household use. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3	Transport of processed timber ^f by logging trucks is implementable using available resources. Testing of timber for LAA after bark and limbs are removed may be necessary to confirm a valuable and safe product for household or commercial use.	\$\$\$	0	Retained	Potentially viable process option.
		Disposal	Disposal of Slash (Former Mine Area)	LAA-impacted bark and limbs generated from processing the timber would be disposed (landfilled) at the Former Mine Area.	3	Protects receptors by minimizing exposure to LAA-impacted bark and limbs at the original site location and provides containment with engineered disposal. Must be combined with removal, transport, and/or treatment technologies. <u>Environmental Impacts:</u> Disposal at the Former Mine Area would result in some short-term environmental impacts due to construction of the disposal cell.	3	Implemented using the former Libby Vermiculite Mine.	\$\$	\$\$	Retained	Potentially viable process option.
		Disposal	Disposal of Slash (Outside OU3 Study Area)	LAA-impacted bark and limbs generated from processing the timber would be consolidated and disposed of at a landfill that accepts friable asbestos waste (e.g., Class IV Landfill).	2	Protects receptors by minimizing exposure to LAA-impacted bark and limbs at the original site location and provides containment with engineered disposal. Must be combined with removal, transport, and/or treatment technologies. <u>Environmental Impacts:</u> Disposal at a location outside of the OU3 Study Area would result in some short-term risk to the environmental during transportation to the off-site location (e.g., loss of containment during transport); however, the risk is considered temporary and minimal.	2	Implementability is considered low due to the volume limits of the facility and the potential for large disposal quantities, need for properly containing waste during transport to limit migration to areas outside of the OU3 Study Area, and requirements to double bag and seal the waste with duct tape.	\$\$\$\$\$	0	Implementability and Cost	Not viable as a solution due to high cost and low implementability.

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<u>Before</u> a Forest Fire (continued)	Treatment	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Slash Generated from Logging	An ACD would be used in conjunction with targeted logging and vegetation management to condense and potentially treat the LAA-impacted bark, limbs, tops removed from the trees at the central processing area(s). The ACD firebox can be either a mobile above ground unit or an in-ground pit. The in-ground ACD design would include a pit dug into the ground with a transportable blower and curtain air plenum positioned to blow the curtain air over and down into pit.	4	Protects receptors by consolidating the LAA-impacted slash generated from logging or vegetation management for disposal. The variable temperature within the unit does not ensure thermal transformation of the LAA into a nonhazardous form (e.g., pyrolysis) but some transformation may occur. Must be combined with removal, and if thermal transformation of the LAA does not occur, transport and disposal technologies may need to be implemented. <u>Environmental Impacts:</u> The installation of an in-ground unit would result in minor disturbance of soils in the selected area. The air emissions generated by the ACD should be evaluated.	3	Implementable in select areas since this design of ACD is common in applications such as destruction of forest-clearing debris. The units are relatively light and can be towed into remote areas (Miller and Lemieux, 2007). If in-ground ACDs are used, pits containing condensed slash can be left in place if covered with clean soil. Excavated soils from the earthen pit would likely contain LAA and would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	0	Retained	Potentially viable process option.
			Slash Pile Burn for Slash Generated from Logging	Slash pile burning would be used in conjunction with targeted logging and vegetation management to condense the LAA-impacted bark, limbs, and tops removed from the trees at the central processing area(s).	2	Protects receptors by consolidating the LAA-impacted slash generated from logging or vegetation management for disposal. It is unlikely any thermal transformation of the LAA would occur from slash pile burning so it would only be effective at consolidating material and is assumed that no treatment would occur. Must be combined with removal and disposal. <u>Environmental Impacts:</u> Habitat in the area where the slash pile burning is conducted would be impacted, and the smoke generated may be disruptive to plants and animals during operation.	2	Implementable in select areas using available construction resources for limited application where ACD application is not feasible or warranted. Implementability is low due to the potential for restrictions on open burning; however, it may be appropriate in certain circumstances when approval can be obtained. Slash pile burning would need to be coordinated with site and climatic conditions (moisture, temperature, wind, etc.). Management and control of the fire and smoke would be required.	\$\$	0	Retained	Potentially viable process option and although effectiveness and implementability are lower as compared to use of an ACD it was retained since it may be appropriate and useful in certain circumstances.

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<u>During</u> a Forest Fire	Containment	Surface Source Controls	Water and/or Chemical Based Suppression	During a forest fire, the ash generated would be contained taking into consideration the procedures outlined in the Wildfire Response Guide for Fire Management Unit 3 (FMU3) (Appendix I of the Kootenai Interagency Dispatch Center Operating Guide) (USDA Forest Service, 2014), modified as appropriate based on the RI/FS results and modified further after implementation of remedy for adjustment based upon reduction of risk. Guidelines addressing LAA risks to firefighting procedures may include: -Use of aviation as first response -Remain outside the fire perimeter -Utilize a wet line to contain and control fire -Respirator requirements -Decontamination procedures for personnel -Personnel tracking -Decontamination/disposal of equipment and supplies -Air monitoring	5	These guidelines would be applied if a forest fire occurs in the Phase 1 Area or in a narrower area based on the RI/FS results and implementation of remedies. A combination of water- and chemical-based suppression would fight and control the fire and would in turn reduce the amount of ash generated. Depending on the severity of the fire, it may be difficult to limit ash mobilization and it could be combined with land use controls to increase protectiveness. <u>Environmental Impacts:</u> There is some potential for impacts to surface water during fire suppression. Consequences of taking no action in a forest fire must be weighed against the impacts of water and/or chemical suppression.	4	Fire response is required and resources are readily available to respond to a forest fire in the Phase 1 Area. Under the current Wildfire Response Guide for FMU3, Rainy Creek and the ponds at the mine site in the OU3 Study Area are not used as water sources, and aviation is set as the initial and primary means of attack.	NA	NA	Retained	Fire response would be required in the event of a forest fire at the Phase 1 Area. The fire would be contained taking into consideration the procedures outlined in the Wildfire Response Guide for FMU3, modified as appropriate based on the RI/FS results and modified further after implementation of remedy for adjustment based upon reduction of risk.

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After a Forest Fire	Containment	Surface Source Controls	Water Based Suppression	For a limited time after a forest fire, LAA-impacted ash would be kept adequately wet using water or a water-based dust suppressant to limit migration of LAA.	2	Protects human receptors by limiting ash mobilization. Water-Based Suppression has the potential to exacerbate the issue of erosion and increased surface water runoff that typically follow forest fires. Runoff produced from water-based suppression has the potential to mobilize the LAA-impacted ash to surface water so careful application would need to be employed and may need to be combined with erosion and run-off controls. <u>Environmental Impacts:</u> Water -Based Suppression would impact natural infiltration rates, create a water imbalance with surrounding habitat, and has the potential to exacerbate the issue of erosion and increased surface water runoff that typically follow forest fires. Runoff produced from water-based suppression has the potential to mobilize the LAA-impacted ash to surface water so careful application would need to be employed to reduce run-off.	2	The implementability depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Trees and areas of steep terrain would limit the ability to use water based suppression, such that if selected as a remedy it would need to be combined with another option. Access to water for suppression is limited by the availability of and rights to use the water sources in the OU3 Study Area and intermittent LAA impacts to surface water sources at the OU3 Study Area. However, use of water at the OU3 Study Area may be appropriate after implementation of remedy. Potentially implementable option for a limited area, but would require frequent wetting possible installation of an irrigation system depending on extent.	\$\$\$	\$\$\$	Not retained due to implementability and increased LAA migration potential	Not viable as a long-term solution, and not retained because it is dependent upon the availability of water and has the potential to induce LAA migration through increases in surface water runoff and subsequent erosion.
		Surface Source Controls (continued)	Chemical Based Suppression	After a forest fire, LAA-impacted ash would be treated with a resinous or petroleum-based chemical dust suppressant (e.g., DusTreat™ DC9136) to limit migration of LAA from the ash. Chemical-based suppression is applied using equipment such as foamers, hydro-seeders or re-plumbed spraying trucks.	2	Protects human receptors by limiting ash mobilization. Re-application would be required periodically to remain effective. Depending on the extent of the forest fire ash, it may only be applicable for select areas and may not be effective at treating all forest fire ash. <u>Environmental Impacts:</u> The application of a chemical-based dust suppressant to LAA-impacted ash after a forest fire could prevent the natural regeneration process of the forest plants and trees, and have potentially negative impacts on the remaining wildlife. Additionally, a chemical based suppressant should be evaluated for potential fire accelerant properties and highly ignitable chemical-based suppressants should be excluded.	2	The implementability depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash. Trees and areas of steep terrain would result in access limitations for equipment used to spray dust suppressant.	\$\$\$	\$\$\$	Not retained due to implementability, and environmental impacts	Not viable as a long-term solution, only applicable to select areas of LAA-impacted ash in the forested area and negative environmental impacts.

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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option		Effectiveness ^c	Implementability ^d	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives	
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<u>After</u> a Forest Fire (continued)	Containment (continued)	Surface Source Controls (continued)	In-Situ Mixing	Select areas of LAA-impacted ash would be mixed (e.g., using a cultivator or disk harrows) with underlying un-impacted soil or fill materials to limit migration of LAA-impacted ash.	1	In-situ mixing for LAA-impacted ash acts to mix ash into underlying soil to minimize surface exposure to, and migration of LAA-impacted ash. The efficacy of this treatment for ash at the Phase 1 Area is relatively low due to loosening of soils and root structures resulting in an increase in mobility and erosion and the possibility that underlying materials contain LAA at higher concentrations (i.e., the concept that underlying materials were exposed during active mining and thus are likely higher in LAA concentration). Root structures remaining after a forest fire prevent mud slides and significant erosional events. If in-situ mixing was applied to ash on the forest floor after a fire, it would increase the susceptibility to erosion and increase potential for migration of LAA-impacted ash, thus has a low efficacy and does not act as a surface source or migration control. According to Robichaud et al, 2010 <i>Post-Fire Treatment Effectiveness for Hill Slope Stabilization</i> , areas are destabilized when wildfires consume plant roots and ground cover that hold soil on hill slopes. In-situ mixing would exacerbate the issue by loosening roots, plants and soils. <u>Environmental Impacts:</u> Root systems would be damaged by the mixing, but since it is only implementable at such a small scale as discussed in the next column, the environmental impact would be minimal. The increased risk of erosion and migration could result in an impact to surface water receptors.	2	Implementable, but only for limited areas, and if it is limited to surface mixing. In-situ mixing is not implementable for the majority of the Phase 1 Area due to steep terrain, density of trees and roots, and areas of shallow bedrock. Also, if mixing with native materials, there would be a need to characterize the concentration profile prior to mixing to evaluate if mixing would bring materials with higher LAA concentrations to the surface. The use of in-situ mixing in a forested environment for the treatment of asbestos has not been previously demonstrated. Deep auger mixing is not considered technically implementable because even with clear cutting, remaining tree stumps and tree and plant roots would hinder the deeper mixing and likely damage the equipment.	\$\$\$	\$	Retained	Potentially viable process option. Due to limited information on its application in a forested environment, in-situ mixing is being retained pending additional information from the Forest Service despite the low effectiveness and implementability scores.
		Surface Source, Erosion, and Migration Controls	Covers / Barriers: Soil or Rock	Select areas of LAA-impacted ash would be covered with a layer of clean soil or rock with sufficient thickness to reduce exposure risks to receptors and limit migration of LAA-impacted ash.	3	Protects human receptors through reducing surface exposure of LAA-impacted ash. Provides protection against erosion, LAA-impacted ash migration and surface water runoff. <u>Environmental Impacts:</u> A soil or rock cover/barrier would alter infiltration rates and cover and damage burrowing animal homes and plants that are key to the forest ecosystem; however, a soil or rock cover is only implementable at a very small scale as discussed in the next column, so the environmental impact would be minimal.	3	Implementable, but only for limited areas. Labor resources to implement would be available, but depends on the availability of materials. Additionally, the implementability depends on the severity of the fire, extent of LAA-impacted ash generated from the fire, and ease of access to locations with LAA-impacted ash.	\$\$\$\$	\$	Retained	Potentially viable process option for a limited area (e.g., along a hiking trail), and although effectiveness and implementability are lower as compared to a Vegetative Cover, it was retained to allow flexibility during design.

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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option	Effectiveness ^c		Implementability ^d		Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
									Capital Cost	O&M Cost		
After a Forest Fire (continued)	Containment (continued)	Surface Source, Erosion, and Migration Controls	Covers / Barriers: Asphalt or Concrete	Select areas of LAA-impacted ash would be covered with layers of asphalt or concrete with sufficient thickness to limit migration of LAA-impacted ash (shotcrete, poured, or rolled).	3	Protects human receptors through reducing surface exposure of LAA-impacted ash. Provides protection against LAA-impacted ash migration. <u>Environmental Impacts:</u> An asphalt or concrete cover/barrier would alter infiltration rates and hinder the natural regeneration process.	2	Implementable, but only for limited areas. Labor resources to implement would be available. The use of shotcrete would allow application to areas with steeper terrain; however, the overall implementability is considered low. Clear cutting of remaining understory/trees prior to application would need to occur, and concrete applied to a forested area has a low administrative and institutional feasibility.	\$\$\$\$	\$	Implementability	Not viable as a solution due to low implementability.
			Covers / Barriers: Vegetative	Select areas of LAA-impacted ash would be covered with a vegetative layer established by application of soil and/or soil amendments (e.g., compost, hydromulch, biochar) and seed mix (e.g., indigenous grasses and plants) by aerial or land application to limit migration of LAA-impacted ash.	4	Protects human receptors by minimizing surface exposure of LAA-impacted ash. Provides protection against erosion, LAA mobilization, and surface water runoff. <u>Environmental Impacts:</u> The erosion control provided is considered a positive environmental impact; however, the addition of an amendment placed in an ecosystem has the potential to disrupt natural processes. The use of indigenous plants and grasses is key to keeping the environmental impacts minimal.	4	Implementable for most areas of the Phase 1 Area depending on application method. Soil amendments can be distributed over fire impacted areas by spraying, thus it could be applied to steep areas depending on access for the trucks. Aerial application significantly reduces the terrain and access challenges. If applied aerially, it is implementable for most of the Phase 1 Area, although areas with a dense canopy would limit consistent application to the ash, thus a combination of aerial and land application may be needed. The cover would need to be coordinated with climatic conditions for proper plant establishment (e.g., do not install during rainy season or winter).	\$\$\$	\$\$	Retained	Potentially implementable option.

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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option		Effectiveness ^c		Implementability ^d	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
									Capital Cost	O&M Cost		
After a Forest Fire (continued)	Containment (continued)	Surface Source, Erosion, and Migration Controls (continued)	Slash Spreading	Tree limbs and branches can be spread on the ash to reduce raindrop impact. If branches are cut small enough (slashed) so that they come in contact with the ash and soil, they will also help disperse overland water flow and reduce runoff and erosion.	3	Protects human receptors through limiting migration of LAA-impacted ash through erosion control. Does not prevent other LAA mobilization. Spreading of slash generated from logging in certain areas within the Phase 1 Area may impact efficacy due to presence of LAA within the bark. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	3	Potentially implementable process option in select areas. If logging or vegetation management activities were performed at the Phase 1 Area, slash would be available. Slash from nearby un-impacted areas also could be used. The use of slash from the Phase 1 Area may have a low associated administrative and institutional feasibility.	\$\$	\$	Retained	Potentially viable option.
		Migration and Erosion Controls	Contour Log Terraces	Dead trees are felled, limbed, and placed on the contour perpendicular to the direction of the slope. Logs are placed in an alternating configuration so runoff is diverted and reduced in velocity and giving water time to percolate into the soil.	3	Protects human receptors through providing erosion control and limiting mobilization of LAA-impacted ash to surface water. Does not prevent other LAA mobilization. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Contour log terraces could be implemented using available construction resources. If dead trees from the Phase 1 Area containing LAA-impacted bark were used, source controls and health and safety controls would need to be utilized during the collection, felling, and de-limbing to protect workers and the environment. Logs should be 15 to 20 feet long and between 4 to 12 inches in diameter to be economically feasible.	\$\$	\$	Retained	Potentially viable for mitigating LAA risks to surface water but does have potential risks involved in felling dead trees from the Phase 1 Area and potential lack of availability of suitable trees.
		Migration and Erosion Controls	Straw Wattles	Straw wattles are long tubes of plastic netting packed with excelsior, straw, or other material. Wattles are used in a similar fashion to log terraces. The wattle is flexible enough to bend to the contour of the slope.	4	Protects human receptors through providing erosion control and minimizing mobilization of LAA-impacted ash to surface water. May not limit other LAA mobilization. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Straw wattles could be implemented in select areas using available construction resources. Straw wattles are available for purchase from erosion control companies. Installation of straw wattles is sometimes combined with trenching in steep areas. If soils are excavated during implementation and contain LAA they would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	\$	Retained	Potentially viable option for mitigating LAA risks to surface water after a forest fire.

Table 4-2c
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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option		Effectiveness ^c		Implementability ^d	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
									Capital Cost	O&M Cost		
After a Forest Fire (continued)	Containment (continued)	Migration and Erosion Controls (continued)	Straw Bale Check Dams	Straw bales placed in small drainages act as a dam collecting sediments from upslope and slowing the velocity of water traveling down the slope. Bales are placed in rows with overlapping joints. Two rows (or walls) of bales are necessary and should be imbedded below the ground line at least six inches.	4	Protects human receptors through providing erosion control and minimizing mobilization of LAA-impacted ash to surface water. May not limit other LAA mobilization. <u>Environmental Impacts:</u> There would be minor disturbances to the ecosystem during implementation.	4	Straw bale check dams could be implemented in select areas using available construction resources. If straw bales are to be imbedded below the ground slightly, excavated soils are likely to contain LAA and would need to be handled and disposed of appropriately (refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	\$	Retained	Potentially viable option for mitigating LAA risks to surface water.
	Removal, Transport, Disposal	Removal	Pneumatic Removal	Select areas of LAA-impacted ash would be removed using vacuum hoses, vacuum trucks, or other pneumatic conveyance system.	2	Protects receptors by reducing future exposure to and the migration of LAA-impacted ash after implementation by removing it. It would only be effective for limited areas where removal can be implemented as described in the next column. <u>Environmental Impacts:</u> Ash acts as a soil amendment providing nutrients for forest re-growth, so removal of it would hinder this process.	2	Pneumatic removal could be implemented using available construction resources; however, implementation would be difficult since ash from a forest fire not only covers the ground but also standing and fallen trees. It would not be technically feasible to remove only ash and partially combusted woody debris and duff and rocky soil would clog and damage equipment during implementation. Depending on where the fire occurs, access limitations (steep terrain, limited road access for equipment) may present challenges for implementation.	\$\$\$\$\$	0	Not retained due to low implementability and higher cost relative to mechanical removal	Not viable as a solution due to low implementability and higher cost relative to mechanical removal.

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Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option	Effectiveness ^c		Implementability ^d	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives	
								Capital Cost	O&M Cost			
After a Forest Fire (continued)	Removal, Transport, Disposal (continued)	Removal	Mechanical Removal	Select areas of LAA-impacted ash would be removed using mechanical methods.	2	Protects receptors by reducing future exposure to and the migration of LAA-impacted ash after implementation by removing it. It would only be effective for limited areas where removal can be implemented as described in the next column. <u>Environmental Impacts:</u> Ash acts as a soil amendment providing nutrients for forest re-growth, so removal of it would hinder this process.	3	Mechanical removal could be implemented using available construction resources; however, implementation would be difficult since ash from a forest fire not only covers the ground but also standing and fallen trees and plant and rock surfaces. Ash on the ground could be removed by mechanical means if underlying materials were also removed (e.g., remaining duff, partially charred debris, surface soils). Depending on where the fire occurs, access limitations (steep terrain, limited road access for equipment) may present challenges for implementation.	\$\$\$\$	0	Retained	Potentially viable process option.
		Transport	Pneumatic Transport	Select areas of LAA-impacted ash would be transported using vacuum hoses, vacuum trucks, or other pneumatic conveyance system to disposal site.	2	Protects receptors by reducing future exposure to and the migration of LAA-impacted ash after implementation by removing it. It would only be effective for limited areas where removal can be implemented as described in the next column. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	2	Pneumatic Transport could be implemented if a portable vacuum truck was used. It can only be applied to locations in the Phase 1 Area where removal of ash by vacuum truck is feasible. Must be combined with removal and disposal technologies. The pneumatic options for transport are limited to vehicles with pneumatic/vacuum systems. Given the fine texture of ash and its ability to become airborne ash would need to be contained in a closed unit during transportation to limit potential migration. Pneumatic removal of ash and subsequent transport by vacuum truck has low implementability due to removal limitations described about under pneumatic removal.	\$\$\$\$\$	0	Higher cost relative to mechanical removal and low implementability	Not viable as a solution due to high cost and low implementability.

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Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
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Applicability ^{a,b}	General Response Actions	Remedial Technology	Process Option	Description of Option			Effectiveness ^c			Implementability ^d	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
											Capital Cost	O&M Cost		
After a Forest Fire (continued)	Removal, Transport, Disposal (continued)	Transport	Mechanical Transport	Select areas of LAA-impacted ash would be transported by truck or other mechanical conveyance method.	2		Protects receptors by reducing future exposure to and the migration of LAA-impacted ash after implementation by removing it. It would only be effective for limited areas where removal can be implemented as described in the next column. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3		Mechanical Transport could be implemented using available construction resources. It can only be applied to locations in the Phase 1 Area where removal of ash is feasible. Must be combined with removal and disposal technologies. Given the fine texture of ash and its ability to become airborne ash would need to be contained in a closed unit during transportation to limit potential migration.	\$\$\$\$	0	Retained	Potentially viable as a long-term solution for select areas; must be combined with removal and disposal technologies.
		Disposal	Disposal (Former Mine Area)	Select areas of LAA-impacted ash would be consolidated and disposed of at the Former Mine Area.	2		Protects receptors by reducing exposure to LAA-impacted duff at the original site location and provides containment with an engineered disposal facility. Must be combined with removal and transport technologies. <u>Environmental Impacts:</u> Disposal at the Former Mine Area would result in some short-term environmental impacts due to construction of the disposal cell.	3		Implementable using the Former Mine Area as the disposal location. Workers would be available to implement disposal and maintain the area; however, the administrative and institutional feasibility is low to moderate.	\$\$	\$\$	Retained	Potentially viable as a long-term solution for select areas where removal is feasible; must be combined with removal and transport technologies.
		Disposal	Disposal (Outside OU3 Study Area)	Select areas of LAA-impacted ash would be consolidated and disposed of at a location outside of the OU3 Study Area.	2		Protects receptors by reducing exposure to LAA-impacted ash at the original site location and provides containment with an engineered disposal facility. Must be combined with removal and transport technologies. It would only be effective for limited quantities due to implementability constraints described in the next column. <u>Environmental Impacts:</u> Disposal at a location outside of the OU3 Study Area would result in some short-term risk to the environmental during transportation to the off-site location.	2		Implementability is considered low due to the volume limits of the facility and the potential for large disposal quantities, the need for properly containing waste during transport to limit migration to areas outside of the OU3 Study Area, and requirements to double bag and seal the waste with duct tape.	\$\$\$\$\$	0	Implementability and Cost	Not viable as a solution due to high cost and low implementability.

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Notes and Abbreviations:

ACD – Air Curtain Destructor
FMU3 – Fire Management Unit 3
FS – Feasibility Study
IC – Institutional Control
LAA – Libby Amphibole Asbestos
LUC – Land Use Control
NA – Not Applicable
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
OU3 – Operable Unit 3
RMS – Risk Management Strategy

- (a) To mitigate risks of forest-fire ash to surface receptors, three phases were considered: 1) Before, 2) During, and 3) After a forest fire. The technologies listed under “During” and “After” should only be considered if a forest fire occurs within the Phase 1 Area.
- (b) It is important to note that recovery actions/remedy selection after a forest fire depends heavily on the amount of damage caused by the fire (i.e., severity of the fire) which can vary greatly depending on weather patterns during the fire and ignition source. As such, it is difficult to select remedial technologies for after a fire since extent and severity cannot be predicted. To remain conservative, some technologies were retained that would only apply to cases where the forest fire was small and of low severity.
- (c) This table presents a preliminary evaluation of the process option effectiveness because it cannot be fully assessed without defining the performance criteria in an accepted Risk Management Strategy (RMS). Because many process options under consideration have potentially significant negative environmental impacts to the forest ecosystem and its related benefits, discussion of the environmental impact has been used to help evaluate the effectiveness of a process option in conjunction with the other evaluation criteria specified in the NCP.
- (d) This table presents a preliminary evaluation of the process option implementability because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).
- (e) The Risk Management Strategy may areas where unacceptable risks were not identified, but remedial actions may be considered as a conservative measure. In these areas, a No Action alternative may be appropriate.
- (f) For the purposes of this table the term processed timber refers to timber that has had all LAA-impacted bark, limbs and leaves removed and can be used for domestic or commercial use.

Table 4-2d
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Bark^a
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General Response Actions	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
No Action	None	None	No action would be taken.	1 There is no action to minimize exposures associated with LAA-impacted bark. However, there is no increase in risk from current conditions if no action is taken. <u>Environmental Impacts:</u> None	1 Easily implemented technically but has low administrative feasibility.	0	\$	Retained	Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as a baseline for comparison. Implementable and appropriate for areas with acceptable risk. ^d
Institutional Controls	Legal Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Tools with IC Components	Legal controls are non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of a response action. Legal controls are typically designed to work by limiting land or resource use or by providing information that helps modify or guide human behavior at a site. Examples that could be used for LAA-impacted bark are the same legal controls applicable to woodstove ash and may include: <ul style="list-style-type: none">Area closures and/or restrictions (e.g., restrictions on collection of wood in select areas within the Phase 1 Area)Restriction on use of woodstoves within the town of LibbyOffer easy access to inexpensive firewood not impacted by LAA	3 Restricts future uses of the Phase 1 Area or select areas of the Phase 1 Area to protect human health or that could compromise the protectiveness of a remedy. ICs would not remove LAA-impacted bark, but would limit access to it. Compliance with legal controls is not guaranteed. <u>Environmental Impacts:</u> None	4 Implementable process option that can be applied to the entire Phase 1 Area and has relatively high administrative and institutional feasibility. There is the potential for public resistance.	\$\$	\$	Retained	Potentially viable process option.
	Risk Communication Controls	Information and Education Programs/ Notification Programs	Risk communication controls would be undertaken to enhance awareness and notify the community of potential hazards and remedies for LAA-impacted bark. An example of a community information and education program includes the Community Advisory Group (CAG). Notifications would be used to inform the community of potential hazards associated with LAA-impacted bark in specific areas, or for specific uses. An example of a risk communication control would be to promote wood collection in forested areas outside of the Phase 1 Area or outside of specific areas within the Phase 1 Area.	3 Protects human receptors through education and notification programs and implementation does not increase risk from the current conditions. Risk communication controls alone do not reduce the mobility, toxicity, or volume of LAA-impacted bark. <u>Environmental Impacts:</u> None	5 Easily implemented using available technical and community involvement labor sources.	\$	\$	Retained	Potentially viable process option.

Table 4-2d
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Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Bark^a
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General Response Actions	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Engineering Controls	Access and Use Management	Access and Use Management	The human health threat posed by burning LAA-impacted bark in woodstoves thus creating LAA-impacted woodstove ash would be reduced by restricting access to some wood sources in the Phase 1 Area. Use and access to areas with LAA-impacted bark would be managed by administrative and/or engineering controls (e.g., fencing and warning signs) to reduce exposure from certain human activities.	4 Protects human receptors through warnings and restricted access through fencing, though human receptors may choose to ignore warnings and circumvent fencing. Does not remove LAA-impacted bark, but would limit access to it. <u>Environmental Impacts:</u> Fencing or other physical barriers providing access control could prevent animal access and/or migration into or out of the Phase 1 Area limiting their access to food sources and shelter. In the event of a fire in the Phase 1 Area, damage to wildlife may be increased due to inability to flee the area.	5 Implementable in select areas. Resources for construction of engineering controls are readily available.	\$\$	\$	Retained	Potentially viable process option.
Removal, Transport, Disposal	Removal	Logging and Processing (Forwarding, Skidding, Cable) (Anderson et al, 2012)	The human health threat posed by burning LAA-impacted bark in woodstoves thus creating LAA-impacted woodstove ash would be reduced through selective logging of areas within the Phase 1 Area (e.g., near the mine site or select areas within the proposed FS focus area). Whole-tree harvesting would be employed such that sources of fuel for use in woodstoves would be removed from portions of the Phase 1 Area. LAA-impacted timber would be transported to a central processing area at the Phase 1 Area by forwarders (wheeled machines with an enclosed operator cab and log bunk), skidders (wheeled machine with a set of bottom-opening grapples used to grab, assemble and hold the logs), or cables (system of overhead cables, support towers, and winches to move whole tress of logs from the forest). The central processing area(s) would be used to process trees into products suitable for either household or commercial use (i.e., de-barking). For example, selective logging of trees was completed on the Grace property in the early 1990s which removed approximately 50% of the trees existing on the Grace property during active mining and processing activities. If another selective logging application were completed that targeted the larger, older trees, the number of trees that remain on the Grace property that existed during active mining and processing activities could be significantly reduced along with any associated risks.	4 Protects receptors by minimizing LAA-impacted bark. Effective only for areas where logging is feasible. Must be combined with transport and disposal technologies to be protective. Erosion controls after logging activities would be required to prevent LAA-impacted soil and duff mobilization. <u>Environmental Impacts:</u> The environmental and erosional impacts of whole tree harvesting for all forested area within the Phase 1 Area would be significant and widespread (e.g., topsoil loss, loss of habitat, removal of trees which absorb a major greenhouse gas [CO ₂])). Deforestation would result in a loss of habitat for species within the Phase 1 Area. Select tree removal may be desirable from a forest management perspective and if done in phases, the environmental impact would be reduced. Despite the challenges of logging in the Phase 1 Area and the environmental impacts, if logging were targeted to select areas, combined with logging techniques to counteract terrain and access issues, and health and safety controls were put in place to protect loggers from exposure to LAA-impacted bark, this method is a potentially feasible option for reducing the risk associated with burning LAA-impacted bark in woodstoves and generating LAA-impacted woodstove ash.	3 Implementable using available logging resources. The extent of LAA-impacted bark and steep terrain would make it difficult to remove all sources. At the central processing area(s), LAA-impacted bark and limbs would need to be removed prior to transport off the OU3 Study Area for household or commercial use. A testing program would be established for the processed logs to provide assurances for proper handling and end-use of materials.	\$\$\$\$	0	Retained	Potentially viable process option.

Table 4-2d
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Bark^a
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General Response Actions	Remedial Technology	Process Option	Description of Option		Effectiveness ^b		Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
								Capital Cost	O&M Cost		
Removal, Transport, Disposal (continued)	Transport of Slash	Mechanical Transport	LAA-impacted bark and limbs generated from processing the timber would be transported by log trucks or other mechanical means to the Former Mine Area for disposal.	3	Protects receptors by limiting future exposure to LAA-impacted bark and limbs after implementation. Must be combined with removal and disposal process options to be protective. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3	Implementable using available construction resources. Health and safety controls and source controls would need to be utilized during implementation to provide protection to workers and the environment.	\$\$\$\$	0	Retained	Potentially viable process option.
	Transport of Processed Timber ^e	Logging Trucks	Processed timber ^e (LAA-impacted bark and limbs removed) would be transported by log trucks outside of the OU3 Study Area for household or commercial use.	4	Protects receptors by providing a source of timber that does not contain LAA at levels that pose unacceptable risk when used commercially or in households for woodstoves. <u>Environmental Impacts:</u> Transport would result in an increase in traffic within the forested areas during removal events temporarily disrupting the ecosystem, but is considered minimal and temporary.	3	Transport of processed timber ^e by logging trucks is implementable using available resources. Testing of timber for LAA after bark and limbs are removed may be necessary to confirm a valuable and safe product for household or commercial use.	\$\$\$	0	Retained	Potentially viable process option.
	Disposal of Slash	Disposal of Slash (Former Mine Area)	LAA-impacted bark and limbs generated from processing the timber would be disposed at the Former Mine Area.	3	Protects receptors by limiting exposure to LAA-impacted bark and limbs at the original site location and provides containment with an engineered disposal facility. Must be combined with removal, transport, and/or treatment technologies to be protective. <u>Environmental Impacts:</u> Disposal at the Former Mine Area would result in some short-term environmental impacts due to construction of the disposal cell.	3	Implementable using the Former Mine Area. Size reduction of slash may need to be conducted prior to disposal.	\$\$	\$\$	Retained	Potentially viable process option.

Table 4-2d
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Bark^a
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General Response Actions	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Removal, Transport, Disposal (continued)	Disposal of Slash	Disposal of Slash (Outside OU3 Study Area)	LAA-impacted bark and limbs generated from processing the timber would be consolidated and disposed of at a landfill that accepts friable asbestos waste (e.g., Class IV Landfill).	2 Protects receptors by minimizing exposure to LAA-impacted bark and limbs at the original site location and provides containment with engineered disposal. Must be combined with removal, transport, and/or treatment technologies. <u>Environmental Impacts:</u> Disposal at a location outside of the OU3 Study Area would result in some short-term risk to the environmental during transportation to the off-site location (e.g., loss of containment during transport); however, the risk is considered temporary and minimal.	2 Implementability is considered low due to the volume limits of the facility and the potential for large disposal quantities, the need for properly containing waste during transport to limit migration to areas outside of the OU3 Study Area, and requirements to double bag and seal the waste with duct tape.	\$\$\$\$\$	0	Implementability and Cost	Not viable as a solution due to high cost and low implementability.
Treatment	Treatment for Volume Reduction	Air Curtain Destructor (ACD) for Slash Generated from Logging	An ACD would be used in conjunction with logging to condense and potentially treat the LAA-impacted bark, limbs, tops removed from the trees at the central processing area(s). The ACD firebox can be either a mobile above ground unit or an in-ground pit. The in-ground ACD design would include a pit dug into the ground with a transportable blower and curtain air plenum positioned to blow the curtain air over and down into pit.	4 Protects receptors by consolidating the LAA-impacted slash generated from logging and debarking for disposal. The variable temperature within the unit does not ensure thermal transformation of the LAA into a nonhazardous form (e.g., pyrolysis) but some transformation may occur. Must be combined with removal, and if thermal transformation of the LAA does not occur, transport and disposal technologies may need to be implemented. <u>Environmental Impacts:</u> The installation of an in-ground unit would result in minor disturbance of soils in the selected area. The air emissions generated by the ACD should be evaluated.	3 Implementable in select areas using available construction resources. The use of in-ground ACDs is particularly common in applications such as destruction of forest-clearing debris because the associated equipment is relatively light and can be towed into remote areas (Miller and Lemieux, 2007). If in-ground ACDs are used, pits containing condensed slash can be left in place if covered with clean soil. Excavated soils from the earthen pit would likely contain LAA and would need to be handled and disposed of appropriately (Refer to Table 4-1b and 4-2b for descriptions on soil removal, transport, and disposal feasibility).	\$\$	0	Retained	Potentially viable process option.

Table 4-2d
Phase 1 Feasibility Study
Screening of Potentially Applicable Remedial Technologies/Process Options Based on Effectiveness, Implementability, and Relative Cost
LAA-Impacted Bark^a
Page 5 of 5

General Response Actions	Remedial Technology	Process Option	Description of Option	Effectiveness ^b	Implementability ^c	Relative Cost		Reasons for Elimination of Process Option from Consideration	Process Option Viability with Respect to Assembly of Remedial Alternatives
						Capital Cost	O&M Cost		
Treatment (continued)	Treatment for Volume Reduction (continued)	Slash Pile Burn for Slash Generated from Logging	Slash pile burning would be used in conjunction with logging to condense the LAA-impacted bark, limbs, and tops removed from the trees at the central processing area(s).	3 Protects receptors by consolidating the LAA-impacted slash generated from logging and debarking for disposal. It is unlikely any thermal transformation of the LAA would occur from slash pile burning so it would only be effective at consolidating material and no treatment would occur. Must be combined with removal and disposal. <u>Environmental Impacts:</u> Habitat in the area where the slash pile burning is conducted would be impacted, and the smoke generated may be disruptive to plants and animals during operation.	2 Implementable in select areas using available construction resources for limited application where ACD application is not feasible or warranted. Slash pile burning would need to be coordinated with site and climatic conditions (moisture, temperature, wind etc.). Management and control of the fire and smoke would be required.	\$\$	0	Retained	Potentially viable process option and although effectiveness and implementability are lower as compared to use of an ACD it was retained to allow flexibility during design.

Notes and Abbreviations:
ACD – Air Curtain Destructor
CAG – Community Advisory Group
FS – Feasibility Study
IC – Institutional Control
LAA – Libby Amphibole Asbestos
LUC – Land Use Control
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
OU3 – Operable Unit 3
RMS – Risk Management Strategy

- (a) Technologies applicable to bark mitigate the woodstove ash risk. If left in place (e.g., the wood is not harvested), intact bark does not present unacceptable risk, so in-situ treatments for bark were not considered.
- (b) This table presents a preliminary evaluation of the process option effectiveness because it cannot be fully assessed without defining the performance criteria in an accepted Risk Management Strategy (RMS). Because many process options under consideration have potentially significant negative environmental impacts to the forest ecosystem and its related benefits, discussion of the environmental impact has been used to help evaluate the effectiveness of a process option in conjunction with the other evaluation criteria specified in the NCP.
- (c) This table presents a preliminary evaluation of the process option implementability because it cannot be fully assessed without defining the scope and extent of the application (e.g., the geographic area and volume of the relevant media).
- (d) The Risk Management Strategy may identify areas where unacceptable risks were not identified, but remedial actions may be considered as a conservative measure. In these areas, a No Action alternative may be appropriate.
- (e) For the purposes of this table the term processed timber refers to timber that has had all LAA-impacted bark, limbs and leaves removed and can be used for household or commercial use.



Attachment A

Preliminary Applicable or Relevant and Appropriate Requirements (ARARs) for the OU3 Study Area



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**PRELIMINARY
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
LIBBY ASBESTOS NPL SITE OU3
February 2016**

*Note that the Preliminary ARARs included herein are considered “Draft” and currently are under stakeholder review. The Preliminary ARARs will continue to be revised as the FS progresses, and Final ARARs will be included in the Record of Decision.

I. INTRODUCTION

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9621(d), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300 (1990), and guidance and policy issued by the U.S. Environmental Protection Agency (EPA) require that remedial actions under CERCLA comply with substantive provisions of applicable or relevant and appropriate standards, requirements, criteria or limitations (ARARs) from State of Montana and federal environmental laws and state facility siting laws during and at the completion of the remedial action.¹ These requirements are threshold standards that any selected remedy must meet, unless an ARAR waiver is justified. Similarly, under the Comprehensive Environmental Cleanup and Responsibility Act (CECRA), § 75-10-701, *et seq.*, MCA, the Montana Department of Environmental Quality (DEQ) “shall require cleanup consistent with applicable state or federal environmental requirements, criteria, or limitations” and “may consider substantive state or federal environmental requirements, criteria or limitations that are relevant to the facility conditions.” Sections 75-10-721(2)(a) and (b) MCA. These preliminary ARARs are also identified as environmental requirements, criteria or limitations (ERCLs) to ensure compliance with Section 75-10-721(2), MCA, of CECRA.

This document identifies ARARs for remedial action to be conducted at Operable Unit 3 (OU3) of the Libby Asbestos Site. OU3 includes, but is not limited to, the mine, the mine property, the Kootenai River and the sediments therein, Rainey Creek, Rainey Creek Road, and areas in which tree bark is contaminated with such hazardous substances and/or pollutants or contaminants. The feasibility study will evaluate remedial alternatives to remediate the Libby Asbestos (LA) in all media at OU3, including, but not limited to, mine waste, groundwater, surface water, soil, duff, ash, and tree bark. The following ARARs or groups of related ARARs are each identified by a statutory or regulatory citation. Substantive provisions of the requirements listed below are identified as ARARs pursuant to 40 CFR § 300.400. No federal, state or local permit shall be required for the portion of any removal or remedial action conducted entirely on site in accordance with section 121(e) of CERCLA.

¹ Based on discussions between the Montana Department of Natural Resources and Conservation, the U.S. EPA, and the DEQ, the Agencies have determined that operation and maintenance of the dam is separate from the CERCLA response actions at the site and further that dam safety laws and regulations and permitting requirements do not fall within the definition of ARARs. Accordingly, these ARARs do not contain such laws including, but not limited to, the Montana Dam Safety Act, Section 85-15-105, *et seq.*, MCA. Instead, the dam safety and permitting requirements are other laws that are applicable independent of CERCLA. If the Agencies identify the dam as part of the final CERCLA remedy, then this determination will need to be reevaluated and such laws included within the ARARs.

II. TYPES OF ARARs

ARARs are either applicable or relevant and appropriate. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental and facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a site. Only State standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.²

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to the hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. Only State standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.³

The determination that a requirement is relevant and appropriate is a two-step process: (1) determination if a requirement is relevant and (2) determination if a requirement is appropriate. In general, this involves a comparison of a number of site-specific factors, including an examination of the purpose of the requirement and the purpose of the proposed CERCLA action; the medium and substances regulated by the requirement and the proposed action; the actions or activities regulated by the requirement and the remedial action; and the potential use of resources addressed in the requirement and the remedial action. When the analysis results in a determination that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable.⁴

ARARs are chemical, location or action specific. Chemical-specific requirements address chemical or physical characteristics of compounds or substances on sites. These values establish acceptable amounts or concentrations of chemicals that may be found in or discharged to the ambient environment.

Location-specific requirements are restrictions placed upon the concentrations of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location specific ARARs relate to the geographical or physical positions of sites, rather than to the nature of contaminants at sites. Action specific requirements are usually technology-based or activity-based requirements or limitations on actions taken with respect to hazardous substances, pollutants or contaminants. A given cleanup activity will trigger an action specific requirement. Such requirements do not themselves determine the cleanup alternative, but define how chosen cleanup methods should be performed.

² 40 CFR § 300.5.

³ 40 CFR § 300.5.

⁴ CERCLA Compliance with Other Laws Manual, Vol. I, OSWER Directive 9234.1-01 (Aug. 8, 1988), pp. 1-11.

Many requirements listed as ARARs are promulgated as identical or near identical requirements in both federal and state law, usually pursuant to delegated environmental programs administered by the EPA and the state. The preamble to the NCP provides that such a situation results in citation to the state provision and treatment of the provision as a federal requirement.

These ARARs are preliminary and are subject to change when the remedy for the Site is selected. The description of ARARs that follows includes summaries of the legal requirements that attempt to set out the requirement in a reasonably concise fashion that is useful in evaluating compliance with the requirement. These descriptions are provided to allow the user a basic indication of the requirement without having to refer back to the statute or regulation itself. However, in the event of any inconsistency between the law itself and the summaries provided in this document, the actual requirement is ultimately the requirement as set out in the law, rather than any paraphrase of the law provided here. Final ARARs will be set forth as performance standards for any and all remedial design or remedial action work plans.

1.0 ACTION-SPECIFIC ARARs

1.1 Water Quality Requirements

1.1.1 Clean Water Act, Point Source Discharges Requirements, 33 USC §1342 (applicable, substantive provisions only): Section 402 of the Clean Water Act, 33 USC §§ 1342, *et seq.*, authorizes the issuance of permits for the discharge of any pollutant. This includes storm water discharges associated with industrial activity. *See*, 40 CFR 122.1(b)(2)(iv). Industrial activity includes inactive mining operations that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations, *see*, 40 CFR 122.26(b)(14)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA subtitle D, *see*, 40 CFR 122.26(b)(14)(v); and construction activity including clearing, grading, and excavation activities, *see*, 40 CFR 122.26(b)(14)(x). Because the State of Montana has been delegated the authority to implement the Clean Water Act, these requirements are enforced in Montana through the Montana Pollutant Discharge Elimination System (MPDES). The MPDES requirements are set forth below.

ARM 17.30.1201 *et seq.*, (standards) and ARM 17.30.1301 *et seq.* (permits) (applicable): If point sources of water contamination are retained or created by any remediation activity, applicable Clean Water Act standards would apply to those discharges. The State of Montana established state standards and permit requirements in conformity with the Clean Water Act, and these standards and requirements apply to point source discharges. *See* ARM 17.30.1201.

ARM 17.30.1203 (applicable): Provisions of 40 CFR Part 125 for criteria and standards for the imposition of technology-based treatment requirements are adopted and incorporated in DEQ permits. For toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not

specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case-by-case basis using best professional judgment (BPJ).

ARM 17.30.1342-1344 (applicable): The State of Montana has been delegated the authority to implement the Clean Water Act and these requirements are enforced in Montana through the MPDES. These regulations set forth the substantive requirements applicable to all MPDES and National Pollutant Discharge Elimination System permits. The substantive requirements, including the requirement to properly operate and maintain all facilities and systems of treatment and control, are applicable requirements.

1.1.2 Montana Water Quality Act, §§ 75-5-101, *et seq.*, MCA:

Section 75-5-605, MCA (applicable), prohibits causing pollution of any state waters. Pollution is defined as contamination or other alteration of physical, chemical, or biological properties of state waters that exceeds that permitted by the water quality standards or the discharge, seepage, or drainage of any substances into state water that will likely create a nuisance or render the water harmful, detrimental or injurious to public health, recreation, safety, or welfare, or to livestock or wild animals. Also, it is unlawful to place or cause to be placed any wastes where they will cause pollution of any state waters.

Section 75-5-303, MCA (applicable), states that existing uses of state waters and the level of water quality necessary to protect the uses must be maintained and protected. Section 75-5-317, MCA, provides an exemption from nondegradation requirements that allows changes of existing water quality resulting from an emergency action or reclamation that is designed to protect the public health or the environment and that is approved, authorized, or required by the department. Degradation meeting these requirements may be considered nonsignificant.

ARM 17.30.637 (applicable), prohibits discharges containing substances that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions that create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials that are toxic or harmful to human, animal, plant or aquatic life; or (e) create conditions that produce undesirable aquatic life.

ARM 17.30.705 (applicable), provides that for all state waters, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the nondegradation rules at ARM 17.30.708.

ARM 17.30.1011 (applicable), provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation may be allowed under the principles established in Section 75-5-303, MCA and the nondegradation rules at ARM 17.30.701, *et seq.*

1.1.3 Stormwater Runoff Control Requirements

ARM 17.24.633 (applicable), provides all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Sediment control through BTCA must be maintained until the disturbed area has been reclaimed, the revegetation requirements have been met, and the area meets state and federal requirements for the receiving stream.

ARM 17.30.1341 (applicable), DEQ issues storm water permits for certain activities. Generally, the permits require the permittee to implement best management practices (BMPs) and to take all reasonable steps to minimize or prevent any discharge that has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, an individual MPDES permit or alternative general permit may be required.

The substantive requirements of both the *Storm Water Discharges Associated with Industrial Activity* MPDES permit (Industrial MPDES permit) and the *Storm Water Discharges Associated with Construction Activity* MPDES permit (Construction MPDES permit) would be applicable, depending upon the location within the site. The Industrial MPDES permit states that it applies to “storm water discharge associated with mining and oil and gas activity as defined in ARM 17.30.1102(29 & 30).” Industrial MPDES permit at 6.

The pertinent definition is in ARM 17.30.1102(30), which provides:

“Storm water discharge associated with mining and oil and gas activity” means the same as the definition for “storm water discharges associated with industrial activity” except that the term pertains only to discharges from facilities classified as standard industrial classifications 10 through 14 (mineral industry) that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of such operations. Such facilities **include active and inactive mining operations** (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(1) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, and except for areas of non-coal mining operations that have been released from applicable state or federal reclamation requirements after December 17, 1990); and oil and gas exploration, production, processing, or treatment operations; and transmission facilities.

“Inactive mining operations” are mining sites that are not being actively mined but that have an identifiable owner/operator, but do not include sites where mining claims are being maintained prior to disturbances associated with the extraction, beneficiation, or processing of mined materials, nor sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim.” (emphasis added).

Applying these definitions, the portions of OU3 that were previously mined are “inactive mining operations,” and thus the Industrial MPDES permit would apply to any storm water that comes into contact with “overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of such operations.” The Construction MPDES permit would apply to all portions of the site that are disturbed as part of the remediation, but

were never actively mined. A permit is not required for the remedial action, but the substantive provisions of the permit must be met.

1.2 Air Standards

These standards, promulgated pursuant to section 109 of the Clean Air Act, 42 U.S.C. §§ 7401, *et seq.*, (applicable) are applicable to releases into the air from any cleanup activities.

Sections 75-2-101, *et seq.*, MCA, (applicable) provide that state emission standards are enforceable under the Montana Clean Air Act.

ARM 17.8.802 (applicable) incorporates by reference the air regulations in certain parts of CFR Title 40 regarding quality assurance requirements for prevention of significant deterioration air monitoring; standards of performance for new stationary sources; emission standards for hazardous air pollutants, and other standards and requirements.

ARM 17.8.805 (applicable) provides ambient air ceilings, and states that no concentrations of a pollutant may exceed concentrations permitted under with the applicable secondary or the primary national ambient air quality standard, whichever concentration is lowest for the pollutant for a period of exposure.

ARM 17.8.204 (applicable) provides for ambient air monitoring and provides that, generally, all ambient air monitoring, sampling and data collection, recording, analysis and transmittal must be in compliance with the Montana Quality Assurance Manual except when MDEQ determines that more stringent requirements are necessary.

ARM 17.8.220 (applicable) prohibits causing or contributing to concentrations of particulate matter in the ambient air such that the mass of settle particulate matter exceeds a 30 day average: 10 gm/m², 30 day average, not to be exceeded. A measurement method is also provided.

Dust control regulations are promulgated at ARM 17.8.223 as part of a federally approved State Implementation Plan (SIP), pursuant to the Clean Air Act of Montana, §§ 75-2-101 *et seq.*, MCA (applicable). Corresponding federal regulations are found at 40 CFR 50.6 (applicable).

ARM 17.8.308 (applicable) provides that no person shall cause or authorize the production, handling, transportation or storage of any material; or cause or authorize the use of any street, road, or parking lot; or operate a construction facility or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken.

ARM 17.8.308 and ARM 17.8.304 (applicable) state that emissions of airborne particulate matter must be controlled so that they do not “exhibit an opacity of twenty percent (20%) or greater average over six consecutive minutes.”

ARM 17.8.604 (applicable) lists certain wastes that may not be disposed of by open burning, including asbestos, asbestos-containing material, oil or petroleum products, RCRA hazardous wastes, chemicals and wood and wood byproducts that have been coated, painted, stained,

treated or contaminated by foreign material. Any waste which is moved from the premises where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry or demolition project) may be open burned only in accordance with the substantive requirements of ARM 17.8.611 or 612. None of the items in ARM 18.8.604 will be disposed of by burning.

Section 82-4-231, MCA, and ARM 17.24.761 (relevant and appropriate) specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of the measures could be considered relevant and appropriate to control fugitive dust emissions in connection with excavation, earth moving and transportation activities conducted as part of the remedy at the facility. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of areas adjoining roads, restricting unauthorized vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands.

1.3 Water Well Requirements

Sections 37-43-101 to 402, MCA (applicable) provides regulations and licensing for drillers or makers of water wells and monitoring wells.

Section 85-2-505, MCA (applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

Section 85-2-516, MCA (applicable) states that within 60 days after any well is completed a well log report must be filed by the driller with the Montana Bureau of Mines and Geology.

ARM 36.21.801 *et seq.* (applicable) specifies certain requirements that must be fulfilled when constructing and abandoning monitoring wells.

1.4 Solid Waste Management Requirements

Ongoing remedial actions at OU3 involve disposal of solid waste at the site (the LA-contaminated soil); therefore, compliance with these ARARs is required.

Montana Solid Waste Management Act and regulations, §§ 75-10-201, *et seq.*, MCA, ARM 17.50.101 *et seq.* (applicable) - Regulations promulgated under the Solid Waste Management Act, § 75-10-201, *et seq.*, MCA, and pursuant to the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 *et seq.* (RCRA Subtitle D) specify requirements that apply to the transportation of solid wastes and the operation, closure and post-closure care of solid waste facilities.

ARM 17.50.503 & 17.50.504, *et seq.* (applicable) sets forth definitions for types of solid wastes including Groups II, III, and IV wastes. The asbestos-free material to be excavated or removed from the site qualifies as a Group III waste. Group III waste must be asbestos-free material. Asbestos-contaminated soil is generally a Group II waste that has to be disposed of at a

Class II landfill. Asbestos waste associated with construction and demolition waste can be disposed of at a licensed Class IV facility, as long as the acceptance is part of the approved facility's O&M Plan and the facility agrees to accept it. Otherwise, waste containing asbestos can only be disposed of at a Class II solid waste facility.

ARM 17.50.509; 17.50.1115 (applicable) "Asbestos-contaminated material," regardless of whether it contains asbestos at greater than 1%, is a "special waste."

ARM 17.50.523 (applicable) specifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling, or leaking from the transport vehicle.

ARM 17.50.1009(1)(c) (applicable) requires that solid waste facilities not discharge pollutants in excess of state standards. A solid waste facility must contain a leachate collection system unless there is no potential for migration of a constituent in Appendix I or II to 40 CFR 258.

ARM 17.50.1204 (applicable) provides solid waste facilities must either be designed to ensure that MCLs are not exceeded or the solid waste facility must contain a composite liner and leachate collection system that complies with specified criteria.

ARM 17.50.1108 (applicable) requires that the owner or operator of a solid waste facility use barriers to control public access.

ARM 17.50.1109 (applicable) requires that owners or operators of solid waste facilities design, construct and maintain a run-on control system to prevent flow onto the active portion of the solid waste facility during the peak discharge from a 25-year storm and a run-off control system from the active portion of the solid waste facility to collect and control at least the water volume result from a 24-hour, 25-year storm.

ARM 17.50.1110 (applicable) prohibits any discharge of a pollutant from a solid waste facility to state waters, including wetlands, that violates any requirement of the Montana Water Quality Act. Prohibits any discharge from a solid waste facility of a nonpoint source of pollution to waters of the United States, including wetlands, that violates any requirement of an area-wide or statewide water quality management plan approved under the Federal Clean Water Act.

ARM 17.50.1111 (applicable) prohibits placement of bulk or noncharacterized waste into a solid waste facility, unless the waste is household waste other than septic liquid waste or leachate derived from and placed back into a facility with a composite liner and leachate collection and removal system.

ARM 17.50.1116 (applicable) sets forth requirements for operation of a solid waste facility, including: that solid waste facilities be created and maintained with supervision, fencing and signage; that owners or operators of solid waste facilities take effective measures to control litter and prevent the public from salvaging materials at the facility; and that the facility be designed to control litter, insects, rodents, odor, residues, waste water, and air pollutants.

ARM 17.50.1403 (applicable) sets forth closure requirements for solid waste facilities. Solid waste facilities must meet the following criteria: (1) install a final cover that is designed to

minimize infiltration and erosion; (2) design and construct the final cover system to minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18 inches of earthen material and has a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils or a permeability no greater than 1×10^{-5} cm/sec, whichever is less; and (3) minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

ARM 17.50.1404 (applicable) sets forth post-closure care requirements for solid waste facilities. Post-closure care must be conducted for a period sufficient to protect human health and the environment. Post-closure care requires maintenance of the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cover and comply with the groundwater monitoring requirements found at ARM Title 17, chapter 50, subchapter 7.

Section 75-10-206, MCA, (applicable) allows variances to be granted from solid waste regulations if failure to comply with the rules does not result in a danger to public health or safety or compliance with specific rules would produce hardship without producing benefits to the health and safety of the public that outweigh the hardship.

40 CFR Part 257 (applicable) establishes standards with which solid waste disposal must comply to avoid possible adverse effects on health or the environment. These criteria apply to any remedial alternatives that require any type of solid waste disposal at the facility. The criteria do not apply to hazardous waste disposal that is subject to regulation under subtitle C of the Resource Conservation and Recovery Act (RCRA). Part 257.3-2 provides for the protection of threatened or endangered species. Part 257.3-3 provides that a facility must not cause the discharge of pollutants into waters of the United States. Part 257.3-4 states that a facility or practice must not contaminate underground drinking water. Part 257.3 states that a facility or practice must not engage in open burning of solid waste. Part 257.3-8 states the explosive limits or other specifics regarding safety.

ARM 17.36.911 *et seq.* (applicable) governs subsurface wastewater treatment systems. If such a system is constructed, altered or extended as part of the remedial action, these regulations apply.

1.5 Hazardous Waste Management Requirements

1.5.1 RCRA, 42 U.S.C. §§ 6901 *et seq.*, (applicable, as incorporated by the Montana Hazardous Waste Act) and the Montana Hazardous Waste Act, §§ 75-10-401 *et seq.*, MCA, (applicable) and regulations.

These Acts establish a regulatory structure for the generation, transportation, treatment, storage and disposal of hazardous wastes. These requirements would be applicable to substances and actions at the facility that involve the active management of hazardous wastes. There are no currently identified hazardous wastes at OU3. These ARARs only apply to remedial actions

involving listed or characteristic hazardous waste, if any such hazardous wastes were identified at OU3.

Wastes may be designated as hazardous by either of two methods: listing or demonstration of a hazardous characteristic. Listed wastes are the specific types of wastes determined by EPA to be hazardous as identified in 40 CFR Part 261, Subpart D (40 CFR 261.30 - 261.33) (applicable, as incorporated by the Montana Hazardous Waste Act). Listed wastes are designated hazardous by virtue of their origin or source, and must be managed as hazardous wastes regardless of the concentration of hazardous constituents, unless eligible for a “no longer contained-in determination.” Characteristic wastes are those that by virtue of concentrations of hazardous constituents demonstrate the characteristic of ignitability, corrosivity, reactivity or toxicity, as described at 40 CFR Part 261, Subpart C (applicable, as incorporated by the Montana Hazardous Waste Act).

ARM 17.53.112 (applicable, as incorporated by the Montana Hazardous Waste Act) specifies that the presence of listed and characteristic hazardous waste require the permit requirements specified below that are applicable for the types of waste management units or the waste management practices anticipated in the remedial actions at the facility.

The RCRA regulations at 40 CFR Part 262 (applicable, as incorporated by the Montana Hazardous Waste Act) establish standards that apply to generators of hazardous waste. These standards include requirements for obtaining an EPA identification number and maintaining certain records and filing certain reports. These standards are applicable for any waste that will be transported off of the facility.

The RCRA regulations at 40 CFR Part 263 (applicable, as incorporated by the Montana Hazardous Waste Act) establish standards that apply to transporters of hazardous waste. These standards include requirements for immediate action for hazardous waste discharges. These standards are applicable for any transportation within the facility. These standards are independently applicable for any transportation off of the facility.

1.5.2 The Montana Hazardous Waste Act, §§ 75-10-401 *et seq.*, MCA (applicable) and regulations.

This Act establishes a regulatory structure for the generation, transportation, treatment, storage, and disposal of hazardous wastes. These requirements are applicable to substances and actions at the facility that involve listed and characteristic hazardous wastes.

ARM 17.53.501-502 (applicable) adopts the equivalent of RCRA regulations at 40 CFR Part 261, establishing standards for the identification and listing of hazardous wastes, including standards for recyclable materials and standards for empty containers, with certain State exceptions and additions.

ARM 17.53.601-604 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 262, establishing standards that apply to generators of hazardous waste, including standards pertaining to the accumulation of hazardous wastes, with certain State exceptions and additions.

ARM 17.53.701-704 & 706-708 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 263, establishing standards that apply to transporters of hazardous waste, with certain State exceptions and additions.

Section 75-10-422 MCA (applicable) prohibits the unlawful disposal of hazardous wastes.

ARM 17.53.1401 (applicable) adopts the equivalent of RCRA regulations at 40 CFR Part 279 that set forth the standards for the management of used oil.

1.6 Reclamation and Revegetation Requirements

Certain portions of the Montana Strip and Underground Mining Reclamation Act and Montana Metal Mining Act, as outlined below, are relevant and appropriate or potentially applicable for activities at the OU3.⁵

ARM 17.24.501 (relevant and appropriate) gives general backfilling and final grading requirements.

ARM 17.24.631 (relevant and appropriate) provides that long-term adverse changes in the hydrologic balance from mining and reclamation activities, such as changes in water quality and quantity, and location of surface water drainage channels must be minimized. Water pollution must be minimized and, where necessary, treatment methods utilized. Diversions of drainages to avoid contamination must be used in preference to the use of water treatment facilities. Other pollution minimization devices must be used, if appropriate, including stabilizing disturbed areas through land shaping, diverting runoff, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming, and toxic-forming waste materials.

ARM 17.24.301(3) defines “Acid-forming materials” as “earth materials that contain sulfide minerals or other materials which, if exposed to air, water, or microbiological or weathering processes, form acids.”

ARM 17.24.301(129) defines “Toxic-forming materials” as “earth materials or wastes which, if acted upon by air, water, weathering, or microbiological processes, are likely to produce chemical or physical conditions in soils or water that are detrimental to biota or uses of water.”

Based on current information and the geology of the area, there may be “acid-forming” and “toxic-forming” materials in OU3.

⁵ Generally, these requirements are relevant and appropriate, however, they may be applicable in certain circumstances. Specifically, the following requirements would be applicable to any areas where the bond has not been released for the full permitted area of 1,025 acres. These requirements would be relevant and appropriate for any areas where the bond has been released, but additional disturbance occurs as part of the final remedy. These requirements are relevant and appropriate for the management and reclamation of all areas of OU3 outside of the permitted area that are disturbed by excavation, grading, or similar actions. The proposed remedial actions will include ground disturbance related to excavation of contaminated soil and duff, among other things.

ARM 17.24.633 (relevant and appropriate) states that all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Treatment must continue until the area is stabilized.

ARM 17.24.635 through 17.24.637 (relevant) set forth requirements for temporary and permanent diversions of surface water.

ARM 17.24.638 (relevant and appropriate) specifies sediment control measures to be implemented during operations.

ARM 17.24.640 (relevant and appropriate) provides that discharge from sedimentation ponds, permanent and temporary impoundments, and diversions shall be controlled by energy dissipaters, riprap channels, and other devices, where necessary, to reduce erosion, prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance.

ARM 17.24.641(relevant and appropriate) indicates that practices to prevent drainage from acid or toxic forming spoil material into groundwater and surface water will be employed.

ARM 17.24.703 (relevant and appropriate) requires that when using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use, and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 17.24.701 and 702.

ARM 17.24.713 (relevant and appropriate) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation, but may not be more than ninety days after soil has been replaced.

ARM 17.24.714 (relevant and appropriate) requires use of a mulch or cover crop or both until an adequate permanent cover can be established. Use of mulching and temporary cover may be suspended under certain conditions.

ARM 17.24.716 (relevant and appropriate) establishes the required method of revegetation, and provides that introduced species may be substituted for native species as part of an approved plan for alternate vegetation.

ARM 17.24.751(relevant and appropriate) measures to prevent degradation of fish and wildlife habitat will be employed.

ARM 17.24.721 (relevant) specifies that rills and gullies must be stabilized and the area reseeded and replanted if the rills and gullies are disrupting the reestablishment of the vegetative cover.

ARM 17.24.761 (relevant and appropriate) requires that fugitive dust control measures will be employed during excavation and construction activities to minimize the emission of fugitive dust.

1.10 Noxious Weed Requirements

Section 7-22-2101(7)(a), MCA (applicable) defines “noxious weeds” as any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities and that is designated: (i) as a statewide noxious weed by rule of the department; or (ii) as a district noxious weed by a board, following public notice of intent and a public hearing.

Designated noxious weeds are listed in ARM 4.5.201 through 4.5.210 (applicable) and must be managed consistent with weed management criteria developed under § 7-22-2109(2)(b), MCA (applicable).

Section 7-22-2152, MCA (applicable) requires that any person proposing certain actions including but not limited to a solid waste facility, a highway or road, a commercial, industrial, or government development, or any other development that needs state or local approval and that results in the potential for noxious weed infestation within a district must notify the district weed board and provide a written plan for establishing a cover of beneficial plants. The plan must describe the time and method of seeding, fertilization practices, recommended plant species, use of weed-free seed, and the weed management procedures to be used. The remedial action must comply with the substantive requirements of a weed management plan.

2.0 CONTAMINANT-SPECIFIC ARARs

2.1 Groundwater Standards

2.1.1 Safe Drinking Water Act – 42 U.S.C. § 300f *et seq.* and the National Primary Drinking Water Regulations (40 CFR Part 141) (applicable) establish MCLs and maximum contaminant level goals (MCLGs) for contaminants in drinking water distributed in public water systems. The requirements were evaluated in this ARARs analysis in conjunction with the ground water classification standards promulgated by the State of Montana.

Chemical	MCLG	MCL
Asbestos fibers longer than 10 microns in length	7 million fibers per liter	7 million fibers liter

2.1.2 The Montana Water Quality Act, §§ 75-5-101, *et seq.*, MCA (applicable) and regulations.

ARM 17.30.1005 and –1006 (applicable) provides that groundwater is classified I through IV based on its beneficial uses. Class I is the highest quality class; class IV the lowest. The groundwater at the Facility is classified as Class I, because it has a natural specific conductance less than or equal to 1,000 microSiemens/cm at 25°C.

ARM 17.30.1006 (applicable) sets the standards and beneficial uses for the different classes of groundwater.

Concentrations of dissolved substances in groundwater may not exceed the human health standards listed in Circular DEQ-7 Montana Numeric Water Quality Standards⁶ (applicable), including narrative standards, which are promulgated pursuant to the state Water Quality Act, §§ 75-5-101, *et seq.*, MCA. Concentrations of other dissolved or suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to beneficial uses. DEQ may use any pertinent credible information to determine these levels. Protection of the beneficial uses of the surface water may require a more stringent cleanup level than the DEQ-7 standard/MCL; (the DEQ-7 standard/MCL applies to fibers greater than 10 microns in length). For fibers less than 10 microns in length, the final cleanup level also must be protective of all beneficial uses.

For the primary contaminant of concern, the DEQ-7 standard is the same as the MCL. Asbestos fibers longer than 10 microns in length must not exceed 7 million fibers per liter. Compliance with all DEQ-7 standards is required and remedial actions must meet the DEQ-7 standards for all contaminants at the facility.

No increase of a parameter that causes a violation of the nondegradation provisions of 75-5-303, MCA, is allowed for groundwater.

ARM 17.30.1011 (applicable) provides that any ground water whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation may be allowed under the principles established in § 75-5-303, MCA, and the nondegradation rules at ARM 17.30.701 *et seq.*

2.2 Surface Water Quality Standards

The Montana Water Quality Act, §§ 75-5-101 *et seq.*, MCA, (applicable) establishes requirements for restoring and maintaining the quality of surface and ground waters and the federal Clean Water Act, 33 U.S.C. §§ 1251 *et seq.*, establishes requirements for restoring and maintaining the quality of surface waters. Under these Acts the state has authority to adopt water quality standards designed to protect beneficial uses of each water body and to designate uses for each water body. Montana's regulations classify state waters according to quality, place restrictions on the discharge of pollutants to state waters and prohibit the degradation of state waters.

ARM 17.30.609 (applicable) provides that all waters in the Kootenai River Drainage except those specifically listed in ARM 17.30.609(1)(a) are classified as B-1; the Rainy Creek drainage to the W.R. Grace Company water supply intake (near the mill pond) is classified as A-1; the Rainy Creek main stem from the W.R. Grace Company water supply intake to the Kootenai River is classified as C-1; and the Kootenai River, Carney Creek and Fleetwood Creek are all classified B-1.

⁶ Montana Department of Environmental Quality, Water Quality Division, *Circular DEQ-7, Montana Numeric Water Quality Standards* (October 2012) ("DEQ-7").

The “A-1” classification standards are contained in ARM 17.30.622 (applicable) of the Montana water quality regulations. Waters classified A-1 are to be maintained suitable for drinking, culinary, and food processing purposes, after conventional treatment for removal of naturally present impurities; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

ARM 17.30.622 provides that concentrations of carcinogenic, bioconcentrating, toxic, radioactive, nutrient, or harmful parameters may not exceed the applicable standards set forth in DEQ-7. For the primary contaminant of concern, asbestos, the DEQ-7 standard is the same as the DEQ-7 standard/MCL for groundwater. Compliance with all DEQ-7 standards is required and remedial actions must meet the DEQ-7 standards for all contaminants at the facility. Asbestos fibers longer than 10 microns in length must not exceed 7 million fibers per liter. The concentration may not exceed this limit in any sample.

Protection of the beneficial uses of the surface water may require a more stringent cleanup level than the DEQ-7/MCL. For fibers less than 10 microns in length, the final cleanup level also must be protective of all beneficial uses.

Water quality standards, including the Circular DEQ-7 Numeric Water Quality Standards and levels necessary to protect all beneficial uses of the surface water, must be met throughout the surface water body. *See* ARM 17.30.601, *et seq.*

The A-1 classification standards at ARM 17.30.622 also include the following criteria: 1) dissolved oxygen concentration must not be reduced below the levels given in department circular DEQ-7; 2) hydrogen ion concentration (pH) must be maintained within specified limits; 3) no increase above naturally occurring turbidity or suspended sediment, except as permitted in 75-5-318, MCA; 4) temperature increases must be kept within prescribed limits; 5) no increase are allowed above naturally occurring concentrations of sediment or suspended sediment, settleable solids, oils, floating solids, which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife; and 6) true color must not increase more than two color units above naturally occurring color.

The B-1 classification standards at ARM 17.30.623 require that the water be maintained suitable, after conventional treatment, for drinking, culinary, and food processing purposes. These waters are also to be maintained suitable for bathing, swimming and recreation, growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and use for agricultural and industrial water supply. This section provides also that concentrations of carcinogenic, bioconcentrating, toxic, radioactive, nutrient, or harmful parameters may not exceed standards set forth in MDEQ circular DEQ-7.

This provision additionally sets limits on escherichia coli bacteria, reduction in dissolved oxygen, changes in pH, increases in turbidity, increases in temperature, and increases in true color. Also, no increases are allowed above naturally occurring concentrations of sediment or

suspended sediment (except as permitted in 75-5-318 , MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

The C-1 classification standards at ARM 17.30.626 require that the water be maintained suitable for bathing, swimming and recreation, growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and use for agricultural and industrial water supply. This section provides also that concentrations of carcinogenic, bioconcentrating, toxic, radioactive, nutrient, or harmful parameters may not exceed standards set forth in MDEQ circular DEQ-7.

This provision additionally sets limits on escherichia coli bacteria, reduction in dissolved oxygen, changes in pH, increases in turbidity, increases in temperature, and increases in true color. Also, no increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318 , MCA) , settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

ARM 17.30.637 (applicable) prohibits discharges containing substances that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions that create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials that are toxic or harmful to human, animal, plant or aquatic life; (e) create conditions that produce undesirable aquatic life. This requirement is applicable to cleanup of the surface water or groundwater and in the event that the remedial action impacts surface or groundwater. Additionally, precautions will need to be put into place to prevent the release of any contamination, including asbestos-containing soils, into the surface water.

ARM 17.30.637 (applicable) also provides that leaching pads, tailing ponds, or water, waste or product holding facilities must be located, constructed, operated and maintained to prevent any discharge, seepage, drainage, infiltration, or flow that may result in pollution of state waters, and a monitoring system may be required to ensure such compliance. No pollutants may be discharged and no activities may be conducted that, either alone or in combination with other wastes or activities, result in the total dissolved gas pressure relative to the water surface exceeding 110 percent of saturation.

ARM 17.30.705 (applicable) provides that for any surface water, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the nondegradation rules at ARM 17.30.708.

2.3 Air Standards

The Clean Air Act (42 U.S.C. §§ 7401 *et seq.*) (applicable) provides limitations on air emissions resulting from cleanup activities or emissions resulting from wind erosion of exposed hazardous

substances. Some of these ARARs, identified as action-specific requirements could also be identified here as contaminant-specific requirements, but will not be repeated.

The National Emission Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61 (applicable) establishes emission standards for specific air pollutants, including asbestos.

Clean Air Act, 40 CFR 61.145 (c) & (d) (relevant and appropriate or potentially applicable).⁷ This requirement establishes detailed standards and specifications for demolition and renovation. The regulation provides detailed procedures for controlling asbestos release during demolition of a building containing “regulated-asbestos containing material (RACM).” Applicable to building demolitions that may occur as part of remedial action if certain threshold volumes of RACM are disturbed. The dust control portions of the regulations are relevant and appropriate for soil disturbance activities and for asbestos-contaminated material that does not meet the strict definition of RACM.

Clean Air Act, 40 CFR 61.149 Note: Section 61.149(c)(2) is not delegated to the State per 40 CFR 61.157 (relevant and appropriate or potentially applicable). This Act and implementing regulations, 40 CFR 61.149, establish detailed procedures and specifications for handling and disposal of asbestos containing waste material (ACM) generated by an asbestos mill. The provision allows an alternative emission control and treatment method.

Clean Air Act, 40 CFR 61.150, Note: Section 61.150(a)(4) is not delegated to the State (relevant and appropriate or potentially applicable) provides standard for waste disposal for manufacturing, fabricating, demolition, renovation, and spraying operations. This regulation provides detailed procedures for processing, handling, and transporting ACM generated during building demolition and renovation (among other sources). Applicable to RACM generated by building demolitions that may occur as part of the remedial action. Relevant and appropriate for soil disturbance activities and for asbestos contaminated material that does not meet the strict definition of RACM.

Clean Air Act, 40 CFR 61.151, Note: Section 61.151(c) is not delegated to the State, (relevant and appropriate or potentially applicable) provides standard for inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations. Provides requirements for covering, revegetation, and signage at facilities where RACM will be left in place. The provision allows an alternative control method.

Clean Air Act, 40 CFR 61.152, Note: Section 61.152(b)(3) is not delegated to the State, (relevant and appropriate or potentially applicable). This requirement establishes detailed specifications for air cleaning used as part of a system to control asbestos emissions control system.

Clean Air Act, 40 CFR 61.154 Note: Section 61.154(d) is not delegated to the State (relevant and appropriate or potentially applicable) sets the standard for active waste disposal sites. Provides

⁷ Where the phrase “relevant and appropriate or potentially applicable” is used in this document, this means that such requirements generally are relevant and appropriate. However, there may be instances where the requirement would be applicable based on a fact-specific analysis.

requirements for off-site disposal sites receiving ACM from building demolitions and other specific sources. These standards would be applicable if any portion of the site meets the definition of active waste disposal site. Otherwise, the provisions would be relevant and appropriate. It is anticipated that only soils will be disposed of at the mine site in OU3. Sections 75-2-101, *et seq.*, MCA, (applicable) provides that state emission standards are enforceable under the Montana Clean Air Act.

The Asbestos Control Act (§§ 75-2-501 *et seq.*, MCA) (relevant and appropriate or potentially applicable) and implementing regulations at ARM 17.74.301 through 17.74.372 establish requirements for asbestos projects. Some of the implementing regulations are discussed in greater detail, below.

ARM 17.74.355, ARM 17.74.359 (relevant and appropriate) Asbestos abatement projects require a permit from Montana Department of Quality (MDEQ). Permits must meet requirements at ARM 17.74.355 and ARM 17.74.359. On-site Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions do not require a permit, but the substantive requirements for performance of the work and proper disposal will be met by the contractors used.

ARM 17.74.357 (relevant and appropriate) establishes air monitoring requirements for asbestos abatement projects, including for building clearance after abatement. These requirements will be followed unless an equivalent or more stringent approach is deemed appropriate by the Agencies.

ARM 17.74.369 (relevant and appropriate or potentially applicable) addresses transportation and disposal of asbestos-containing waste. Transportation requirements must be met for all LA (*i.e.*, the asbestos must be adequately wet, contained in leak-tight packaging, and both the asbestos waste and the vehicle transporting it must comply with labeling requirements). This ARAR specifies that the asbestos-containing waste must be deposited at a licensed Class II or Class IV landfill facility as soon as practical, or, if asbestos-containing waste is not disposed of as soon as practical, store any asbestos-containing waste in a secure holding facility or location accessible only to asbestos project workers or asbestos project contractor/supervisors accredited by the department. This provision also requires that the entity responsible for transport and disposal retains responsibility for the asbestos-containing material (ACM) until the waste is accepted by a licensed Class II or IV landfill. The regulations are relevant and appropriate for the transportation and disposal of all LA, even if the LA does not meet the definition of asbestos-containing waste. This requirement would be applicable to the handling of any asbestos-containing waste, as defined in ARM 17.74.352(4).

If the remedial action involved any enclosure, encapsulation, or repair of asbestos, the following ARARs would be applicable to the handling of RACM as defined in 40 CFR §61.141; asbestos-containing waste as defined in ARM 17.74.352(4); and ACM as defined in ARM 17.74.352(3). The regulations are also relevant and appropriate for the enclosure/encapsulation/repair of all other LA, even if it does not meet the definition of ACM/RACM/asbestos-containing waste, except for soils.

ARM 17.74.370; Section 75-2-502(3), MCA, (relevant and appropriate or potentially applicable) address requirements for asbestos enclosure. Asbestos enclosure must meet specific handling requirements (*i.e.*, use of amended water; removal/repair of loose or hanging ACM; application requirements; labeling/marketing the repaired ACM; and meeting the clearance requirements in ARM 17.74.357).

An “asbestos project” is “the encapsulation, enclosure, removal, repair, renovation, placement in new construction, demolition of asbestos in a building or other structure, or the transportation or disposal of asbestos-containing waste.” The term does not include a project that involves less than 10 square feet in surface area or 3 linear feet of pipe.

ARM 17.74.371 (relevant and appropriate or potentially applicable) addresses requirements for asbestos encapsulation. A person may not conduct asbestos enclosure procedures for an asbestos project unless accredited by the department as an asbestos project worker or asbestos project contractor/supervisor. Additionally, specific handling requirements (*i.e.*, use of amended water; removal/repair of loose or hanging ACM; application requirements, including that it be applied in a manner that does not dislodge or disturb the ACM; and meeting the clearance requirements in ARM 17.74.357) must be met.

ARM 17.74.372 (relevant and appropriate or potentially applicable) states that asbestos repair must meet specific handling requirements (*i.e.*, use of amended water; removal/repair of loose or hanging ACM; application requirements, including that it be applied in a manner that does not dislodge or disturb the ACM; labeling the repaired ACM; and meeting the clearance requirements in ARM 17.74.357).

Clean Air Act, 75-2-101, MCA; ARM 17.8.204; ARM 17.8.206 (relevant and appropriate) require that all ambient air monitoring, sampling and data collection, recording, analysis, and transmittal be in compliance with the Montana Quality Assurance Manual, except when more stringent requirements are determined to be necessary. These requirements will be followed unless an equivalent or more stringent approach is deemed appropriate by the Agencies.

The requirements of ARM 17.8.204 apply to “any ambient air monitoring performed by the department or any other entity that is: (a) required by this chapter; (b) used to demonstrate compliance with this chapter; (c) submitted in an application for, or to comply with a condition of, a permit under this chapter; or (d) used to satisfy any applicable requirement of Title 75, chapter 2, MCA, or the federal Clean Air Act, 42 USC 7401 through 7671g, or implementing regulations, for which the department has oversight.” Therefore, under the terms of the rule, it applies to all air contaminants for which compliance with ARARs at OU3 must be demonstrated.

ARM 17.8.220 (applicable) provides that no person may cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds a 30-day average of 10 gm/m^2 . A measurement method is also provided.

ARM 17.8.221 (applicable) provides concentrations of particulate matter in ambient air must not exceed annual average scattering coefficient of 3×10^{-5} per meter.

ARM 17.8.223 (applicable) provides PM-10 concentrations in ambient air must not exceed a 90 day average of 1.5 micrograms per cubic meter of air and an annual average of 50 micrograms per cubic meter of air.

Ambient air standards under section 109 of the Clean Air Act are also promulgated for carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, ozone, and lead. If emissions of these compounds were to occur at the facility in connection with any cleanup action, these standards would also be applicable. *See* ARM 17.8.210, 17.8.211, 17.8.212, 17.8.213, 17.8.214, and 17.8.222.

3.0 LOCATION-SPECIFIC ARARS

3.1 Endangered and Sensitive Species.

3.1.1. The Endangered Species Act (applicable). This statute and implementing regulations (16 U.S.C. § 1531 *et seq.*, 50 CFR Part 402, and 40 CFR 257.3-2) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat. Compliance with this requirement involves consultation with the U.S. Fish and Wildlife Service (USFWS) and a determination of whether there are listed or proposed species or critical habitats present at the facility, and, if so, whether any proposed activities will impact such wildlife or habitat.

According to the Montana Natural Heritage Preservation Center, the grizzly bear is known to be present in Flathead County.

3.1.2 Montana Nongame and Endangered Species Act, §§ 87-5-101 *et seq.* (applicable): Endangered species should be protected in order to maintain, and to the extent possible, enhance their numbers. These sections list endangered species, prohibited acts and penalties. *See also*, § 87-5-201, MCA, (applicable) concerning protection of wild birds, nests and eggs; and ARM 12.5.201 (applicable) prohibiting certain activities with respect to specified endangered species.

3.2 Migratory Bird Treaty Act

This requirement (16 USC §§ 703 *et seq.*) (applicable) establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the appropriate program within the USFWS during remedial design and remedial construction to ensure that the cleanup of the facility does not unnecessarily impact migratory birds.

3.3 Bald Eagle Protection Act

This requirement (16 USC §§ 668 *et seq.*) (applicable) establishes a federal responsibility for protection of bald and golden eagles, and requires continued consultation with the appropriate program within the USFWS during remedial design and remedial construction to ensure that any cleanup of the facility does not unnecessarily adversely affect the bald and golden eagle.

3.4 Historic Sites, Buildings, Objects and Antiquities Act

These requirements, found at Section 1866(a) of Title 18, Crimes and Criminal Procedure, and sections 102303 and 102304 and chapter 3201 of Title 54, National Park Service and Related Programs, by Pub. L. 113–287, §§3, 4(a)(1), 7, Dec. 19, 2014, 128 Stat. 3094 , 3260, 3272. , (applicable) provide that, in conducting an environmental review of a proposed action, the responsible official must consider the existence and location of natural landmarks using information provided by the National Park Service pursuant to 36 CFR § 62.6(d) to avoid undesirable impacts upon such landmarks.

Montana Human Skeletal Remains and Burial Site Protection Act, MCA 22-3-801 *et seq.*, (applicable) requires the reporting of any discovery of human remains to the county coroner immediately. The act requires work to cease until the coroner makes certain determinations.

3.6 Fish and Wildlife Coordination Act

These standards are found at 16 USC § 661 *et seq.* and 40 CFR 6.302(g) (applicable) and require that federally funded or authorized projects ensure that any modification of any stream or other water body affected by a funded or authorized action provide for adequate protection of fish and wildlife resources.

3.7 Floodplain Management Order

Executive Order 11988 (referenced in 40 CFR Part 35, Appendix A to Subpart H) (applicable) requires federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In addition, application of the Montana floodplain requirements (see below) addresses protection of the floodplain.

3.8 Protection of Wetlands Order

This requirement (Executive Order No. 11,990, referenced in 40 CFR Part 35, Appendix A to Subpart H) (applicable) mandates that federal agencies and potentially responsible parties avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.

Section 404(b)(1), 33 U.S.C. § 1344(b)(1) (applicable) also prohibits the discharge of dredged or fill material into waters of the United States. Together, these requirements create a “no net loss” of wetlands standard.

3.9 Solid Waste Management Requirements

Regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 *et seq.*, MCA, (applicable) specify requirements that apply to the location of any solid waste management facility. The solid waste ARARs would apply to the “active management” of asbestos-contaminated soil. Excavating and placing the wastes in a repository would constitute “active management” of the wastes.

ARM 17.50.1004 (applicable) specifies a solid waste facility located within the 100-year floodplain may not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste that poses a hazard to human health or the environment. *See also* ARM 17.50.1009(1)(h) (applicable).

ARM 17.50.1005 (applicable) specifies a solid waste facility may not be located in a wetland, unless there is no demonstrable practicable alternative.

ARM 17.50.1006 (applicable) specifies a solid waste facility cannot be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time without demonstration that an alternative setback will prevent damage to the structural integrity of the solid waste facility and will be protective of human health and the environment.

ARM 17.50.1007 (applicable) specifies a solid waste facility may not be located in a seismic impact zone without demonstration, by a Montana licensed engineer, that the solid waste structure is designed to resist the maximum horizontal acceleration in lithified earth material for the site.

ARM 17.50.1008 (applicable) specifies a solid waste facility may not be located in an unstable area (determined by consideration of local soil conditions, local geographic or geomorphologic features, and local artificial features or events, both surface and subsurface) without demonstration, by a Montana licensed engineer, that the solid waste facility is designed to ensure that the integrity of the structural components will not be disrupted.

ARM 17.50.1009 (applicable) sets forth general requirements applying to the location of any solid waste facility. Among other things, the location must have sufficient acreage, including adequate separation of wastes from underlying groundwater or adjacent surface water, must be located so as to prevent pollution of ground, surface, and private and public water supply systems, and must allow for reclamation of the land.

Under ARM 17.50.1009, a facility for the treatment, storage or disposal of solid wastes:

1. must be located where a sufficient acreage of land is suitable for solid waste management, including adequate separation of wastes from underlying ground water or adjacent surface water;⁸
2. must be located where local roads are capable of providing access in all weather conditions and local bridges are capable of supporting vehicles with maximum rated loads;
3. must be located in a manner that does not allow the discharge of pollutants in excess of state standards for the protection of state waters, public water supply systems, or private water supply systems;

⁸ The extent of separation shall be established on a case-by-case basis, considering terrain and the type of underlying soil formations, and facility design.

4. drainage structures must be installed where necessary to prevent surface runoff from entering waste management areas; and
5. must be located to allow for closure, post-closure, and planned uses of the land.

Section 75-10-212, MCA (applicable) prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted. However, the restriction relating to privately owned property does not apply to the owner, his agents, or those disposing of debris or refuse with the owner's consent.

3.10 Floodplain and Floodway Management Act and Requirements

The following standards are included here to indicate the restrictions on any related activities that might occur in or affect the floodway or floodplain. Portions of OU3 are located within or near the floodplain or floodway; the following ARARs must be evaluated when conducting remedial actions.

Section 76-5-401, MCA and ARM 36.15.601 (applicable) provide that residential, certain agricultural, industrial-commercial, recreational, and other uses are permissible within the designated floodway, provided they do not require structures other than portable structures, fill or permanent storage of materials or equipment.

Section 76-5-402, MCA and ARM 36.15.701 (applicable) provide that in the flood fringe (*i.e.*, within the floodplain but outside the floodway), residential, commercial, industrial, and other structures may be permitted subject to certain conditions relating to placement of fill, roads, and floodproofing.

ARM 36.15.602(5), 36.15.605, and 36.15.703 (applicable) provide that solid and hazardous waste disposal and storage of toxic, flammable, hazardous, or explosive materials are prohibited anywhere in floodways or floodplains.

Section 76-5-402, MCA (applicable) states that the following are prohibited in a floodway: any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; and the construction or permanent storage of an object subject to flotation or movement during flood level periods.

Section 76-5-406, MCA and ARM 36.15.216 (applicable) contain substantive factors that address obstruction or use within the floodway or floodplain.

ARM 36.15.604 (increase in upstream elevation or significantly increase flood velocities), ARM 36.15.602(1) (excavation of material from pits or pools), and ARM 36.15.603 (water diversions or changes in place of diversion) (applicable) provide further conditions or restrictions that generally apply to specific activities within the floodway or floodplain.

ARM 36.15.701(3)(d) (applicable) provides that structures and facilities for liquid or solid waste treatment and disposal must be floodproofed to ensure that no pollutants enter flood waters and may be allowed and approved only in accordance with DEQ regulations, which include certain additional prohibitions on such disposal.

ARM 36.15.901 (applicable) requires electrical systems to be flood-proofed.

The variance provisions at ARM 36.15.218(1) (applicable) allow actions within the floodplain or floodway under certain conditions:

- (a) the proposed use would not increase flood hazard either upstream or downstream in the area of insurable buildings;
- (b) refusal of a variance would because of exceptional circumstances cause a unique or undue hardship on the applicant or community involved;
- (c) the proposed use is adequately flood proofed; and
- (d) reasonable alternative locations outside the designated floodplain are not available.

3.11 Natural Streambed and Land Preservation Act

Section 75-7-111, MCA, (applicable) provides that a person planning to engage in any activity that will physically alter or modify the bed or banks of a stream must give written notice to the Board of Supervisors of a Conservation District, the Directors of a Grass Conservation District, or the Board of County Commissioners if the proposed project is not within a district, and must submit a "310 Permit" application to one of those entities. Although a permit is not required, the substantive provisions of the permit must be met.

ARM 36.2.404 (applicable) establishes minimum standards which would be applicable if a remedial action alters or affects a streambed, including any channel change, new diversion, riprap or other streambank protection project, jetty, new dam or reservoir or other commercial, industrial or residential development. Reasonable efforts must be made consistent with the purpose of the project to minimize the amount of stream channel alteration, ensure that the project will be as permanent a solution as possible and will create a reasonably permanent and stable situation, ensure that the project will pass anticipated water flows without creating harmful erosion upstream or downstream, minimize turbidity, effects on fish and aquatic habitat, and adverse effects on the natural beauty of the area, and ensure that streambed gravels will not be used in the project unless there is no reasonable alternative. Soils erosion and sedimentation must be kept to a minimum. Such projects must also protect the use of water for any useful or beneficial purpose. See § 75-7-102, MCA.

Sections 87-5-502 and 504, MCA, contain similar provisions, and require that a state agency or subdivision not construct, modify, operate, maintain or fail to maintain any construction project or hydraulic project that may or will obstruct, damage, diminish, destroy, change, modify, or vary the natural existing shape and form of any stream or its banks or tributaries in a manner that will adversely affect any fish or game habitat. The requirement that any such project must eliminate or diminish any adverse effect on fish or game habitat is applicable to the state in approving remedial actions to be conducted.

3.12 National Forest Management Act

The National Forest Management Act (16 U.S.C. §§ 1600-1614), U.S. Forest Service Planning Rule (36 C.F.R. § 219.15(d)), and the Kootenai National Forest Land Management Plan (2015 Revision), 80 Fed. Reg. 2096 (Jan. 15, 2015), (all applicable) contain requirements that apply to the National Forest Systems lands.

The Kootenai National Forest Land Management Plan, 2015 Revision (the “LMP”), contains standards and management direction for all actions to be taken on National Forest Systems lands within the Kootenai National Forest boundaries. All remedy components and all materials developed for the remedy or lands disturbed by any portion of the remedy will follow the applicable standards and management direction (collectively “plan components”) set forth in the LMP. Plan components apply either: Forestwide; to a specific Management Area; or to a specific Geographic Area. In addition to the Forestwide plan components, the LMP ARARs would be the Libby Geographic Area plan components and the plan components for the following Management Areas, as defined in the Kootenai NF LMP: Eligible Wild and Scenic Rivers (MA2); Backcountry (MA5a); General Forest (MA6); and Primary Recreation Areas (MA7). Examples of plan component ARARs include: FW-STD-VEG-01, FW-STD-TBR-01 through -07, which control timber harvest and other vegetation management activities Forestwide; and FW-DC-FIRE-01, -02, and GA-DC-FIRE-LIB-01, -02, which set forth direction for firefighting and fire management activities Forestwide and within the Libby Geographic Area. The management area boundaries are identified in the 2015 Forest Plan map, which is available at <http://go.usa.gov/cVEkm>.

The plan component ARARs for particular portions of the Selected Remedy would be identified and complied with through the remedial design process and implemented during activities at the Site.

3.13 U.S. Forest Service Roadless Area Conservation Rule

The 2001 U.S. Forest Service Roadless Area Conservation Rule (the roadless rule), 36 C.F.R. part 294 (2001), 66 Fed. Reg. 3244-3273 (Jan. 12, 2001) (applicable) contains requirements that apply to a certain portion of National Forest Systems lands within OU3. Maps depicting this specific area are available at <http://go.usa.gov/cVHjw>. The roadless rule generally prohibits road construction, reconstruction, and timber harvest in inventoried roadless areas, but provides for certain exceptions to these prohibitions, including for CERCLA response actions.



Attachment B

Response to Comments provided by stakeholders



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Draft Identification and Screening of Technologies Technical Memorandum Phase I Feasibility Study - Stakeholder Comments								
Comment Number	Agency	Agency Personnel	Report Section	Page	Paragraph	Sentence	Stakeholder Comments	Response to Comments
1	EPA	Progeess	3.1	2	4	2	The demarkation of OU4 from OU3 should be based on land use. Various land uses may apply to a single private parcel. To the extent that the OU3 boundary to be used in the FS includes private property, the portion of the property that is used frequently by residents (e.g. homes, yards, other frequently used areas) will be included in OU4. However if these properties contain forested/meadow/pasture areas where the use of the property is limited, these forested/meadow/pasture areas will be included in OU3. In areas where the entire private property parcel is forested and undeveloped, this shall be considered OU3. Additionally, if a residential private parcel were located on the Kootenai River but the only portion of the property where contamination was found was below the high water mark of the Kootenai River, this material would be considered part of OU3 and would be included in the OU3 remedy.	Text modified accordingly. Residential risk scenarios were not evaluated as a part of OU3. Based on EPA input, the forested/meadow/pasture areas within privately held parcels inside of the Phase 1 footprint are included in OU3 and the land use is considered private, non-residential land use as defined in Section 3.1. The Kootenai River portion of the comment was not included in the revised text since it is not applicable to Phase 1, but will be addressed during Phase 2 when the Kootenai is considered.
2	CDM Smith	Hazen	3.1	2	4	2	The statement "any properties geographically within OU3 that are currently residential will be evaluated as part of OU4" should be cited to the appropriate reference document as the non-OU3 FS which evaluated residential/commercial land uses does not have a statement confirming this assumption.	Reference to the Non-Asbestos HHRA has been added.
3	MDEQ	--	3.1	4	4	2	This section states: “any properties geographically within OU3 that are currently residential will be evaluated as part of OU4.” Please revise to state that the ‘back forty’ or infrequently used/unused areas of the properties will be retained as OU3, with the residential, yards, and garden areas being retained as OU4. The portions of properties that lie below the high water mark along the Kootenai should also be considered OU3.	See response to comment #1.
4	CDM Smith	Hazen	3.1.2.3	3	1	Bullet 1	The bullet is unreadable in the PDF version received. I presume it to be similar to bullets 1 and 2 within Section 3.2.1.3 of the non-OU3 FS.	Formatting of the bullet has been fixed.
5	MDEQ	--	3.1.2.3	3	1	Bullet 1	The first bullet is unreadable. Please revise to make it legible, and there may be an additional comment. 3. Section 3.1.4, Last Bullet: Please clarify that this waiver only applies to response actions conducted pursuant to Section 9604 (i.e., response actions using the “Superfund”).	Formatting of the bullet has been fixed. Section 3.1.4 Last Bullet - The referenced text has been revised as follows to provide clarity: "In meeting the ARAR, the remedial action will not ensure a balance between the need for protection of public health and welfare and the environment at the site and the availability of Superfund monies to respond to other facilities. This waiver only applies to response actions conducted pursuant to Section 42 U.S.C. §9604 "
6	CDM Smith	Hazen	3.1.7	6	1		EPA has previously provided a tentative list of ARARs for OU3- is there a reason they were not included with this memorandum?	Preliminary ARARs have been added to this technical memorandum as an attachment.
7	MDEQ	--	3.2	--	--	--	Please note that DEQ's acceptable risk level is not to exceed 10 ⁻⁵ .	Note that the PRAOs identified in Section 3.2 were provided by EPA. Our understanding is that the MDEQ acceptable risk level threshold of 10 ⁻⁵ is applicable to surface water and groundwater, which are not included in the Phase 1 FS. OU3 Study Area surface water and groundwater will be addressed in the Phase 2 FS. The preliminary ARAR list is included as an attachment, which references the DEQ-7 Circular that includes DEQ's acceptable risk level.
8	CDM Smith	Hazen	4.3	8	2	Exhibit 4-1	EPA has indicated that they prefer the GRA of "land use controls" to be renamed as "Institutional Controls" for consistency with their guidance. If that GRA involves physical measures such as fencing or signage, it should be indicated as a separate GRA category (e.g. access controls, engineered controls, etc.). I noticed that this comment is reflected on Page 9 so this may simply have been a consistency oversight.	Exhibit 4-1 has been revised for consistency.
9	CDM Smith	Hazen	4.3	8	3	2	It is not clear why or how "no action" would be selected for portions of the Phase 1 area. By definition in Section 4.1, LAA-impacted media have levels of LAA considered to unacceptable human health risks, which would in turn indicate some form of action is required (even if it is a limited action such as ICs or monitoring).	The referenced text has been revised as follows: "Additionally, there may be areas where unacceptable risks were not identified, but remedial actions are considered as a conservative measure. In these areas, a No Action alternative may be appropriate.."
10	CDM Smith	Hazen	4.5	10	1/3	1/Bullet 1	Lack of availability is usually addressed in the second step of technology/process option screening, so may be premature to screen out in the first (technical implementability) step solely for that reason. This is described in Section 4.6.1 of the memo.	The referenced text has been deleted.

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11	EPA	Progeess	4.6.1	11	1	1	Impacts to forest ecosystem should be evaluated as one of many factors when developing and comparing alternatives. Some impacts may be necessary to provide a protective remedy, improve fire suppression effectiveness, and reduce concentrations below a level of concern in impacted media.	It is understood that ecological impact may not be completely unavoidable but has been used as one of several criteria in evaluating the effectiveness of a process option in accordance with the NCP criteria (e.g., potential impacts to human health and the <u>environment</u> during construction and implementation). To align with the NCP criteria for evaluating the effectiveness of a process option, the word "ecological" has been changed to "environmental" when discussed in Table 4-2s. See also response to comment #12.
12	CDM Smith	Hazen	4.6.1	11	1	1	While green and sustainable considerations are important to EPA as part of a CERCLA action, the criterion indicated is not explicitly identified in CERCLA or the NCP. To avoid the concern of a deviation from the NCP and related RI/FS guidance, recommend this be reworded to indicate it is a consideration of the previously identified subcriterion for effectiveness (i.e. potential impacts to human health and the environment during construction and implementation). In addition, this aspect of evaluation should also take into account the multiple use goals of the USDA Forest Service as indicated in their forest management plan that may be conservation- rather than preservation-oriented; for instance harvesting of trees may not only be acceptable but encouraged in some locations and situations under the forest plan. Additional input from the USDA Forest Service should be solicited on this matter.	The referenced text has been reworded to indicate the NCP effectiveness criterion of potential impacts to human health and the environment has been expanded to consider the short and long term environmental/ecological impact of implementation given the area is a forested environment containing threatened, endangered and candidate species. The environmental/ecological impact evaluations were reviewed with a focus on conservation rather than preservation as well as consideration to the Forest Service multiple use goals.
13	CDM Smith	Hazen	4.7	12	1	3	Suggest rewording this part of the section to remove references to the stakeholder's interests. I would instead suggest discussing the concept that while multiple technologies of the same type were not screened out, only one was selected as representative to be assembled into alternatives but the others could be viable as identified during RD for specific situations or locations. The suggested wording change is subtle but important so there is not a perception that stakeholder requests caused a deviation from guidance.	The referenced text has been modified as suggested.
14	CDM Smith	Hazen	4.7	13	1	Exhibits	Please update as needed for consistency with comments on retention of technologies/process options as indicated in the screening tables.	The exhibits have been updated to reflect revisions to Table 4-1s and 4-2s based other comments.
15	Forest Service	--	4.7	13, 14		Exhibit 4-3, 4-4 and 4-5: Biochar	Bio-char is not effective not very effective on contaminants which are a hazard because of their physical structure. The statement may want to say “Covers/barriers: products that physically bind contaminants in place such as tactifiers.”	The intention was to use biochar as a soil amendment for vegetation establishment. However, as a result of a revised approach to vegetative covers, the biochar cover process option is no longer a separate process option. Biochar is still listed as a possible soil amendment under vegetative cover since it has the ability to promote vegetation growth and has been used for such purposes at the Aspen Hope Mine (e.g., used for slope stabilization at this former silver mine).
16	Forest Service	--	4.7	13, 14		Exhibit 4-3, 4-4 and 4-5: Added Item to "Surface Source and migration control"	May want to add in entrainment into soils or sub-soils to lessen the susceptibility of release of fiber associated with LA. This is based on the premise that the contamination is based on airborne deposition that is limited to upper portion of the soil/sub-soil horizons, as well as dust controls could be implemented in the process.	Entrainment of LAA into soils or sub-soils is assumed to be covered in the in-situ mixing process option. See response to comment #23 on in-situ mixing.

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17	Forest Service	--	Table 4-1a	1		Monitored Natural Recovery	The process as described by” “ A monitoring program would evaluate the rate of decline of LAA from mining activities at established intervals (e.g. in advance of each Five year review)”, may not necessarily be realistic because depending of the natural environment it may take decades to finally decompose the duff to see a change. The LAA is not a volatile compound which this process was probably meant to address.	The rate of natural decomposition and the duff generation at the site is undefined and may take decades. Monitoring on an interval of every 5 years to support the Five Year Review report is reasonable based on the anticipated rate of change. Monitored Natural Recovery is not specific to volatile compounds but is generally used as a remedial approach for contaminated sediments that relies on natural physical, chemical, and biological processes to isolate, destroy, or otherwise reduce the bioavailability or toxicity of contaminants (USEPA, 2005, NRC, 1997). Using Monitored Natural Recovery as the descriptor of the technology seems appropriate as the mechanism for reduction in concentration and risk is similar.
18	MDEQ	--	Table 4-1a	Page 1	Row 2	MNA	This should be potentially applicable to a portion of the site, or potentially applicable as a final portion of the remedy. It seems contradictory to other later entries in the tables, where it is stated “...would not prevent deposition of new duff that may be generated from LAA-impacted trees.”	The deposition of new duff that may be generated from LAA-impacted trees is one of many factors used to evaluate the technology's effectiveness. This criteria was not used solely to screen out a technology. The assumption for MNR is that the LAA concentration would reduce over time (new duff would have a reduced concentration over duff produced during mining activities) and will provide incremental reductions in the availability of LAA to become airborne when disturbed.
19	CDM Smith	Hazen	Table 4-1a (others as appropriate)			GRAs	According to EPA's “Institutional Controls: A Site Manager’s Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups” (2000), ICs are non-engineered instruments such as administrative or legal controls. Physical barriers such as fencing are specifically identified in the guidance as not being considered ICs by EPA (Page 2). Suggest making engineered controls a separate GRA and the remedial technology could be named "access controls", the converse, or something similar to differentiate from ICs.	The tables have been modified to make engineering controls a separate GRA, independent of ICs.
20	CDM Smith	Hazen	Table 4-1a (others as appropriate)			Ecological Impacts	Ecological impacts, if not specifically a factor that precludes the technical implementation of a technology/process option, are more appropriately used in the second step of technology screening, specifically under the effectiveness subcriterion of "(2) the potential impacts to human health and the environment during the construction and implementation phase". We would recommend that it not be used as the sole basis for screening out technologies/process options unless the ecological impact represents a "fatal flaw" in implementing a technology (e.g. would harm T&E species, cause irreversible damage to a sensitive ecosystem, etc.).	The ecological impact statements have been removed from the 4-1 tables and are not discussed until the second screening step in the 4-2 tables. The term ecological impact has been changed to environmental impact to better reflect RI/FS guidance. See responses to comments #11 and 12.
21	Forest Service	--	Table 4-1a (others as appropriate)	1		Legal Controls - Governmental Controls	To make this relate to a Forest environment it should be referenced in terms of “area closures”.	"Area closures and/or restrictions" has been added to the list of IC examples on the tables.
22	Forest Service	--	Table 4-1a (others as appropriate)	1		Engineering Controls - Access Restrictions	Need to be mindful that the type of fencing that is outlined in various guidance documents calls for fence to be 6 to 8 feet tall and made of chain link or wire mesh which is impractical to install in a forested environment. This leaves only fencing types such as barbed wire that does not impact wildlife movement to a great degree.	The type of fencing is not being identified at this stage of the process. However, during a later stage in the FS process the type of fencing and associated impacts to wildlife movement will be considered.

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Comment Number	Agency	Agency Personnel	Report Section	Page	Paragraph	Sentence	Stakeholder Comments	Response to Comments
23	Forest Service	--	Table 4-1a (others as appropriate)	2		In-situ Mixing	This process should be retained because it is possible in varying landscapes (open parks and low tree density environments) to utilize tiling as an options provided that dust suppression can be implemented and effective.	The tables have been modified to retain In-situ Mixing as a technically implementable option for limited areas with the following caveat on the 4-2 tables: "Due to limited information on its application in a forested environment, in-situ mixing is being retained pending additional information from the Forest Service despite the low effectiveness and implementability scores." This caveat is included because: (1) in-situ mixing has relatively low effectiveness due to loosening of materials resulting in an increase in mobility and erosion; (2) the need to characterize the concentration profile prior to mixing to evaluate if mixing would bring materials with higher LAA concentrations to the surface which impacts implementability, effectiveness, and cost (i.e., the concept that underlying materials were exposed during active mining and thus are likely higher in LAA concentration); (3) relatively low implementability due to very limited areas where implementation would be technically feasible; (4) the use of In-situ mixing in a forested environment or for the treatment of asbestos has not been previously demonstrated.
24	CDM Smith	Hazen	Table 4-1a (others as appropriate)			Covers/Barriers	The rationale for screening out of asphalt/concrete and geosynthetic covers in the first step of screening would probably be enhanced by deemphasizing technical implementability factors that could be overcome; e.g. presence of understory, since large scale clearing and grubbing of understory vegetation is a fairly common and conventional practice in the construction of covers at contaminated sites. Stronger rationale at this step of screening could involve emphasizing the other factors identified such as remoteness, steep and rocky terrain, and the presence of significant quantities of large trees that preclude the placement/seaming to meet impermeable cover objectives. Also burrowing animals are common at landfill and other cover sites and can be successfully mitigated in a multilayer cover using a biological barrier layer so that line of evidence, in of itself, is not particularly strong as a primary or standalone line of evidence.	The screening process for the covers/barriers has been modified in light of comments provided by the Stakeholders (see response to comment #25). Upon re-evaluation, asphalt/concrete cover was retained in 4-1a, b, and c since application of shotcrete to limited areas is considered technically feasible, but has been screened out in 4-2a, b, and c using the addition of suggested verbiage. The geosynthetic cover option was not retained past 4-1. The potential for animal disturbance to the covers has been removed as a screening criteria.
25	CDM Smith	Hazen	Table 4-1a (others as appropriate)			Covers/Barriers	The rationale for screening out technologies that are similar to others that were retained is not entirely clear. For instance the only apparent technical difference between vegetative covers and mulch/seed is the need for soil placement as part of the vegetative cover. It would seem that vegetative covers, while maybe not appropriate for the entire forest, could be appropriate for duff in certain locations. Some of the rationale used to retain mulch/seed (e.g. the presence of plants could limit burrowing animals after establishment) would be true of vegetative covers as well but was used as a reason to eliminate. If after reevaluation the placement of vegetative cover is still deemed to not be technically implementable, recommend that technical factors common to the geosynthetic and asphalt covers (steep terrain, rocky areas, etc.) that impair the technology's objective be emphasized over those that are shared with the retained technologies (e.g. mulch/seed).	The intention in the draft version of the Technical Memorandum #1 was to screen out based on the application method. Biochar cover, Vegetative cover, and Mulch and Seed process options have been combined into one vegetative cover process option to remove redundancies and inconsistencies and allow flexibility during the design phase. This broader definition of vegetative cover is included in the 4-1 tables and vegetative cover is being retained.
26	Forest Service	Forest Service	Table 4-1a (others as appropriate)	3		Biochar	Biochar is more of a process to chemically absorb contaminants. Since the concern is LAA (a physical shape structure that is not prone to absorption) it would make great sense to have a process to immobilize the structures.	The intention was to use biochar as a soil amendment for vegetation establishment; however, the biochar cover process option has been combined into one process option for vegetative covers (see response to comment #25). Biochar is still listed as a possible soil amendment under vegetative cover since it has the ability to promote vegetation growth and has been used for such purposes at the Aspen Hope Mine (e.g., used for slope stabilization at this former silver mine).

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Comment Number	Agency	Agency Personnel	Report Section	Page	Paragraph	Sentence	Stakeholder Comments	Response to Comments
27	Forest Service	Forest Service	Table 4-1a (others as appropriate)			Vegetative Cover	May want to maintain this process. It is correct that it does not stop new material such as contaminated bark from being deposited, but if your vegetation management calls for the removal of trees with debarking at another site it may make sense to maintain the duff layer in place and a continued vegetation cover may be a solution.	Biochar cover, Vegetative cover, and Mulch and Seed process options have been combined into one vegetative cover process option to remove redundancies and inconsistencies and allow flexibility during the design phase. Thus, a broader definition of vegetative cover is included in the 4-1 tables and vegetative cover is being retained.
28	MDEQ	MDEQ	Table 4-1a (others as appropriate)	4,5		Vegetative Cover	On page 4, “vegetative cover” is not retained as a cover/barrier, as it is not deemed implementable. On page 5, essentially the same vegetative cover is retained as an option for migration and erosion control. Please retain BOTH of these options as potentially implementable, at least in portions of the site.	See response to comment #25.
29	CDM Smith	Hazen	Table 4-1a (others as appropriate)			Removal	Recommend reevaluating the elimination of pneumatic removal for duff and soil, and possibly ash. While it may be true that it is not a conventional approach currently used for management of national forests, it is a conventional tool for extraction of contaminated soils and has also been used by the landscaping industry for large scale management of leaf litter. If the concern is that it has not been demonstrated, this may be a candidate for a treatability study to determine the effectiveness and implementability of this approach which on its face could have some advantages over mechanical removal in some situations or locations such as uneven or steep terrain.	Pneumatic removal has been retained in Tables 4-1a, b, and c based on technical implementability for limited areas. The use of pneumatic removal was eliminated in Tables 4-2a, b, and c based on implementability and cost.
30	Forest Service	Forest Service	Table 4-1a			Pneumatic Removal	Retained-No? I thought in our previous call that this would be retained as a “Tool in a Toolbox”	See response to comment #29.
31		MDEQ	Table 4-1a			Pneumatic Removal	DEQ does not agree that this option should be removed from consideration, as it could potentially be used to address select areas of higher contamination.	See response to comment #29.
32	CDM Smith	Hazen	Table 4-1a (others as appropriate)			Transport	While it would seem reasonable to eliminate pneumatic transport, a significant technical implementibility reason to consider might be the long distances for transport which may not be achievable with the sizes of blowers and their power requirements.	Pneumatic transport was retained in Tables 4-1a, b, and c for the purposes of including the use of transport by vacuum track after removal. This is consistent with the approach to pneumatic extraction in the sitewide FS. The use of pneumatic removal and transport was eliminated in Tables 4-2a, b, and c based on implementability and cost.
33	CDM Smith	Hazen	Table 4-1a (others as appropriate)			Disposal	Is disposal outside of OU3 really unimplementable from a technical perspective, especially for a subset of contaminated media? Certainly other aspects of implementiblity and costs may come into a decision as part of the second step of screening but clearly it is technically possible once excavated to transport and dispose of LA-contaminated media at other locations outside of OU3. During the second step of screening the higher costs, short term impacts to the community, and logistical/administrative implementability issues could be considered and invoked to eliminate as appropriate.	Requirements for disposal in the Class IV landfill includes double bagging the waste and closing with duct tape, which was not considered technically feasible; however, in light of considering a subset of contaminated media it has been retained as technically feasible in Table 4-1s, then screened out in Table 4-2s for implementability and cost considerations.
34	MDEQ	MDEQ	Table 4-1b	2		In-situ mixing and Covers/Barriers	Both in-situ mixing and covers/barriers are not retained. Would it not be reasonable to keep these options in for portions of the site where the site conditions would be favorable ?	See responses to comments #23, #24 and #27.
35		MDEQ	Table 4-1b			Vegetative Cover	Would it not be reasonable to keep this option in for portions of the site where the site conditions would be favorable ?	See responses to comments #24 and #27.
36	CDM Smith	Hazen	Table 4-1c			Ash	As indicated before per EPA guidance, ICs do not involve physical activities so not only should the access restrictions be moved to a separate GRA but also the fire management activities. From my perspective fire management activities are a form of containment (source controls) but could easily be deemed engineered controls as well.	Engineering controls has been separated from ICs as a stand-alone GRA in all Table 4s.
37	Forest Service	Forest Service	Table 4-1c			Governmental Controls	See comment for impacted duff. In addition, this method may not protect because the media is prone to migration by wind and water.	Other process options would be combined with ICs in the development of alternatives for areas where migration control was desired.
38	CDM Smith	Hazen	Table 4-1c			Ash	All removal, transport, and disposal options for ash generated after a fire were screened out. Other aspects of implementability and costs may come into a decision as part of the second step of screening but clearly it is technically possible once excavated to transport and dispose of LA-contaminated media at other locations inside and outside of OU3, depending on the scale of the fire. During the second step of screening the higher costs, short term impacts to the community, and logistical/administrative implementability issues could be considered and invoked to eliminate as appropriate. Otherwise you will need to define a forest fire in terms of size that lead to the conclusion it is unmanageable to remove and dispose of ash generated from them. Footnote b however seems to allude that some technologies were retained assuming a fire of small scale and intensity.	Both pneumatic and mechanical removal and transport have been retained for on-site and off-site disposal in Table 4-1c for limited quantities. In addition, disposal off OU3 has been retained for limited quantities of duff, soil, ash, and slash generated from logging.

Draft Identification and Screening of Technologies Technical Memorandum Phase I Feasibility Study - Stakeholder Comments								
Comment Number	Agency	Agency Personnel	Report Section	Page	Paragraph	Sentence	Stakeholder Comments	Response to Comments
39	EPA	Progeess	Table 4-1c	4 of 9		In-situ Mixing of Ash	in-situ mixing should be retained for ash	See response to comment #23. In addition to the general reasons for ranking low for effectiveness and implementability listed in the response to #23, root structures remaining after a forest fire prevent mud slides and significant erosional events. If in-situ mixing was applied to ash on the forest floor after a fire, it would increase the area's susceptibility to erosion and increase potential for migration, thus has a low efficacy and does not act as a surface source or migration control. According to Robichaud <i>et al</i> , 2010 <i>Post-Fire Treatment Effectiveness for Hill slope Stabilization</i> , areas are destabilized when wildfires consume plant roots and ground cover that hold soil on hill slopes. In-situ mixing would exacerbate the issue by loosening roots, plants and soils.
40	Forest Service	Forest Service	Table 4-1c			In-situ Mixing of Ash	See Comment for impacted duff. Also note that depending on the severity of the fire generating the ash, the eco-system is altered and features that may impact a greater implementation (i.e.. Trees, brush, stumps, etc.) may not be a factor.	See response to comment #39.
41	MDEQ	MDEQ	Table 4-1c	4		In-situ Mixing of Ash	This option should be retained. Did the slash pile burn not show that mixing brought ABS results to a more acceptable risk level?	ABS data are used to calculate risks during a specific activity (e.g., slash pile construction or mop-up), but cannot be used to presume that a reduction in LAA concentrations in the soil / ash due to mixing resulted in a reduction in HQ values for the different activities.
42	Forest Service	Forest Service	Table 4-1c			Covers/Barriers - Vegetative Cover	This option should be left in place to act as a means to stabilize material in place	See response to comment #24.
43	MDEQ	MDEQ	Table 4-1c	6		Vegetative Cover	Would it not be reasonable to keep this option in for portions of the site where the site conditions would be favorable ?	See response to comment #24.
44	Forest Service	Forest Service	Table 4-1d	2		Logging and Processing	This item is an excellent one. The only element that would need to be addressed is the issue of that after processing at the Mine site, the processed logs need to be inspected/tested to ensure that the there would be no litigation issues from LAA exposure at an outside mill.	Added the following text to address this concern in Tables 4-2c and 4-2d, "A testing program would be established for the processed logs to provide assurances for proper handling and end-use of materials."
45	CDM Smith	Hazen	Table 4-2a			Slash Spreading	It appears effectiveness based rationale (risks/migration and treatment efficacy) is provided in the implementability column; recommend moving that rationale to the effectiveness column.	Effectiveness based rationale was moved from implementability column to the effectiveness column.
46	CDM Smith	Hazen	Table 4-2a, 4-2c			Straw Bales Check Dams	While they could be effective at preventing further migration in overland flow channels, it would seem not to be effective at mitigating direct surface exposure or migration until it got to the check dam.	The remedial technology for straw bales, straw waddles, and contour logs has been modified from Surface Source and Migration Control to Migration and Erosion Control in both Table 4-1s and 4-2s.
47	CDM Smith	Hazen	Table 4-2a			Open Burning	It is not clear why implementability is so low- especially administrative feasibility and need for skilled workers. What specifically is a challenge administratively or from a skill level? Is this fire restrictions? Presumably skill to perform open burning is not any different than slash pile burning-maybe some of the rationale from that evaluation (Table 4-2c) should be brought to this table.	Open burning and slash pile burning has been retained and may be appropriate in certain circumstances when approval can be obtained; however, both of these process options were considered to have low administrative feasibility relative to the air curtain destructor due to increased emissions and possible restrictions on open burning. Rationale for the implementability of slash pile burning provided in Table 4-2c has been used in Table 4-2a.



Attachment C

**Final Meeting Minutes Feasibility
Study Collaboration Bi-Weekly
Calls: January 14, 2016, February
11, 2016, February 25, 2016,
March 10, 2016, and April 7, 2016**

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MEETING 1 MINUTES

Meeting 1: Feasibility Study Collaboration Bi-weekly Call Operable Unit 3 Study Area, Libby Asbestos Superfund Site

January 14, 2016 @ 9 am MT

Call In: 1-855-549-6718; Conference ID: 8142684

Company	Contact	Present
EPA	Christina Progress	Yes
EPA	Dania Zinner	Yes
MDEQ	Lisa DeWitt	Yes
USACE	Teresa Reinig	No
W.R. GRACE	Bob Marriam	Yes
W.R. GRACE	Bob Medler	Yes
W.R. GRACE	Tony Penfold	Yes
USFS	Bob Wintergerst	Yes
CDM Smith	Gary Hazen	Yes
CDM Smith	Scott Felton	No
Integral Consulting Inc.	Patrick Gwinn	Yes
Integral Consulting Inc.	Russ Keenan	No
MWH Americas, Inc.	Bill Pickens	Yes
MWH Americas, Inc.	Stacey Arens	Yes
MWH Americas, Inc.	Natalie Zeman	Yes
MWH Americas, Inc.	Tony Magliocchino	Yes

Format:

Main Discussion topics – **Bold and Underlined**

Subtopics - **Bold**

Dialogue – *Italicized*

Conclusions/Decisions – **Highlighted**

1. General Discussion:

Introductions and Stacey discusses the goals of the meeting including: develop open communication, obtain input from stakeholders, and develop consensus on the approach of Memo #1.

Meeting discussions will be documented and sent out by the MWH team within 1-2 days of the meetings. The meeting minutes will reflect MWH's interpretation of items discussed and determined at the meeting. Attendees should review the meeting minutes and provide comments to MWH if there are disagreements or pertinent items that were missed. Otherwise the meeting minutes will be used as a record of the meetings.

2. Memo #1 Schedule

ACTION 1: MWH to provide Technical Memo #1 to FS Stakeholders by COB on the posted due date. At the next meeting (Jan-28) the Memo will already be in internal review, so review and feedback of the draft tables sent Monday evening is requested soon (See Action 4 below).	MWH	Feb-5
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3. Memo # 1 Outline and Scope Discussion

What IS NOT Included:

- RALs/RCC will be included in RMS and not in Tech Memo #1 – RMS will be conducted parallel to Memo 1
- ARAR discussion within Section 3 will be generic and point to an ARAR appendix which will be provided after consensus on the ARARs is complete.

Christina: *Concerned about coordinating on the RMS. Suggests to the group that we have a meeting where the overall direction of the RMS is discussed prior to getting too far along in it.*

ACTION 2: MWH to set up an RMS meeting including this meeting's attendees and Deb McKean to cover RMS and obtain concurrence on the scope and direction.	MWH	Jan-19
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The team agrees that RALs cannot be included in Memo #1 until the RMS is complete.

- Phase 2: mine site, areas disturbed by mining activities (including the rock disposal area, tailings piles, the amphitheater, rock quarries, mining access roads such as Rainy Creek Road, and previously reclaimed areas), and water bodies (e.g., the impoundments dam, Rainy Creek, Carney Creek, Fleetwood Creek, and the Kootenai River).
- Mine waste is not included.

The team thinks this is OK, but EPA is to confirm.

ACTION 3: EPA to provide concurrence that mine waste PRAO should not be included in Phase I and thus not included in Memo #1.	EPA	Jan-15
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- Sections 1 and 2 not included, but will be included in Draft FS – Want RI text ironed out before putting into FS

The team agrees that Sections 1 and 2 can be left out of Memo #1.

What IS Included:

Items Identified in SOW dated 12.15.15

- GRAs→Technology Types→Process Options (descriptions, contaminated media to which they apply)
- Initial screening of these (Tables 4-1, 4-2)
- Land Use Categories
- Sections 3 (RAOs) and 4 (ID and Screening) of the FS as presented in the Draft Outline sent to the team

Christina: *Will the details of the ARARs will be included?*

Stacey: *Specific ARARs will not be provided, but the general explanation of how they apply to the site and the ARAR process will be included in section 3. The Draft FS will include an appendix with the detailed ARARs.*

Christina agrees with this approach.

- Phase 1 addresses areas of OU3 adjacent to the mine site (e.g., forested areas not disturbed by mining activities and roads not used for mining access) that are not subject to Phase 2.

Stacey: *Outline – In line with EPA guidance and largely mirrors Sitewide FS*

EPA provides concurrence on the Outline and Scope of Memo #1. Forest Service also agrees with the approach.

Gary: *How will areas and volumes be applied to the initial screening?*

Stacey: *We don't have these yet, not defined until RMS is complete, so this weakness will remain in Tech Memo 1.*

4. Table 4-1 and 4-2 Discussion

Stacey: *Does the team see any conflict between tables and SOW? – EPA says covers what needs to be covered and did not see a conflict.*

EPA agrees based on their preliminary review of the tables that there is no conflict between the SOW and the Tables and that MWH is headed in the right direction.

Tables 4-1

Stacey: *Overarching comments should be discussed now. Smaller, more detailed comments should be sent via email by COB Friday, January 15.*

ACTION 4: Team to provide small/detailed comments back on Tables 4-1 and 4-2 to MWH by COB via email.	FS Stakeholders	Jan-15
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Overarching Comments:

Christina/Bob: *Seems you have screened out many technologies due to terrain/extent – looking at it for selective use – Do not be too premature in screening out technologies where it could be applied on a smaller scale. For example, on the duff table – Soil mixing – would be applicable and beneficial because soil mixing would incorporate duff deeper into the soil. Could also be useful for ash.*

Gary: *Soil/Rock Cover barrier, not viable – but what about hiking path, should be retained for consideration*

Christina: *Slash Pile Burn – might want to retain, could use as useful tool for disposal of slash material depending on location; let's retain both ACD and Slash Pile burn*

Stacey: *Does the team agree with the approach for Forest Fire Ash?*

Gary: *Why have Before forest fire? If there is no forest fire ash, then the technologies are not targeting a media type.*

Stacey: *“Before” is meant to deal with fire management. For example, vegetation management would be to mitigate the risk for forest fire, and not necessarily targeted at reducing duff/soil risks*

Bob (USFS): *Wants to think on it a bit, but thinks on the right path*

Gary: *Technologies are supposed to focus on contaminated medium – can treat it as diversion of forest fire similar to diversion of water around contamination. May provide more input with review of tables.*

Christina: *On the right track with forest fire ash.*

Tables 4-2

Christina: *Retain more and list which circumstances where we can apply and where not feasible*

Stacey: *There is concern with retaining too many such that the number of alternatives become onerous, so the most applicable process option within one technology type would be retained*

Gary – Appreciates limitation so alternatives do not become onerous. There are two ways we can avoid having too many alternatives.

- 1- Retain multiple similar technologies, then select one for the alternative. Using just one that is the most applicable for costing and screening FS purposes, but retain others so that they may be used in actual design
- 2- Assemble alternatives with focuses – Containment focus, Removal focus, Treatment focus

Christina: Agrees with Gary's suggestion. Retain more in Memo #1, then use a representative process option in Memo #2 for costing/alternative development purposes

Lisa and Bob: Yes concept makes sense and are in agreement with retaining more technologies but then not applying to specific technologies (select one to represent the group, then the specific one will be selected during design – provides flexibility during design)

Team agrees that there is benefit to retaining more process options that are similar that could be used in select areas or for select cases for Memo #1, then screen out during the identification of alternatives (Memo #2) to streamline number of alternatives and simplify costing, but allow flexibility for use of all during the design phase.

Gary: Something that will need to be considered down the line. Will development of alternatives be specific to media types or more holistic? For example, duff/soil could be combined, which could also make number of alternatives more manageable.

Stacey: Duff and soil are likely the only media types that could be combined, but it will be considered when alternatives are being developed.

Gary: May want to review site-wide FS for consistency on nomenclature related to GRAs. On a couple GRAs (LUC approach) headquarters wanted to stick to ICs instead of LUCs and Engineered Controls separate – take a look at site-wide. Monitored Natural Recovery (MNR) – there is a definition in CERCLA for sediment so maybe it needs to be called MNA.

ACTION 6: MWH to revise Tables based on team feedback prior to submittal for internal review. Retain more process options with consideration to application to limited areas and specific cases to allow flexibility during the design phase. MWH to review site-wide FS for GRA consistency check and consider revision of MNR to MNA.	MWH	Jan-25
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5. Next Meeting

Date: January 28 at 9 am (meeting recurrence will be extended beyond the two meetings)

Note: Memo 1 will be in internal review already

Upcoming Topics

- Sections 3 and 4 Text – will already be in internal review so no opportunity to review and discuss in the next meeting
- Building Materials – have memo to team before next meeting
- Land Use Categories – have initial thoughts on Land Use Categories to team before next meeting
- Phase I/II Boundary – Separate meeting
- Comment Template – have template sent to FS stakeholders for input and comment before next meeting

ACTION 7: In addition to a meeting for RMS (Action 2), MWH to send out meeting schedule for ARAR/Data Gaps/ Phase 1 and Phase 2 boundary.	MWH	Jan-15
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MEETING 2 MINUTES

Meeting 2: Feasibility Study Collaboration Bi-weekly Call Operable Unit 3 Study Area, Libby Asbestos Superfund Site

February 11, 2016 @ 9 am MT

Call In: 1-855-549-6718; Conference ID: 8142684

Company	Contact	Present
EPA	Christina Progross	Yes
EPA	Dania Zinner	Yes
MDEQ	Lisa DeWitt	Yes
USACE	Teresa Reinig	No
W.R. GRACE	Bob Marriam	Yes
W.R. GRACE	Bob Medler	Yes
W.R. GRACE	Tony Penfold	Yes
USFS	Bob Wintergerst	Yes
CDM Smith	Gary Hazen	Yes
CDM Smith	Scott Felton	No
Integral Consulting Inc.	Patrick Gwinn	No
Integral Consulting Inc.	Russ Keenan	Yes
MWH Americas, Inc.	Bill Pickens	Yes
MWH Americas, Inc.	Stacey Arens	Yes
MWH Americas, Inc.	Natalie Zeman	Yes
MWH Americas, Inc.	Tony Magliocchino	Yes

Format:

Main Discussion topics – **Bold and Underlined**

Subtopics - **Bold**

Dialogue – *Italicized*

Conclusions/Decisions – **Highlighted**

Action Items – **BOLD, CAPITALIZED** meeting number they were identified in – number for order identified during meeting. Cumulative action items (i.e., open items from previous meetings and all items from meeting herein) are summarized in tables on the last page of notes.

1. Schedule:

Technical Memo #1 sent to stakeholders Feb 5, 2016

2. General Housekeeping – Attendance and Meeting Minutes

Stacey: *Did the method of sending Draft Meeting Minutes for feedback, then sending final version out work for everyone?*

Meeting discussions will be documented and sent out by the MWH team following the meeting. Attendees should review the draft meeting minutes and provide comments to MWH if there are disagreements or pertinent items that were missed within one week of receipt. Otherwise the meeting minutes will be submitted to the stakeholders as final and be used as a record of the meetings.

The team agrees the method seemed to work well, so we should continue the same moving forward.

3. Questions Regarding Phase I Technical Memo #1

Stacey: Does anyone have comments or questions to discuss regarding the Phase I Tech Memo?

No comments or questions at this time. The group needs more time to review.

Christina: *Please add comments to Technical Memo #1 to the agenda for the March meeting.*

4. Process for Comments from Stakeholders

Christina: All agencies will send comments to me and I will review to make sure there are no opposing comments, compile and send to MWH. What format?

Stacey: *Please provide comments in the Excel table format provided as an attachment to the Memo.*

Christina: *I can send comments after reviewing but will likely be in multiple tables rather than consolidated to one.*

ACTION 2-1: Stakeholders to provide comments to Christina in the Excel table format provided for review.

Christina to review comments on Technical Memorandum #1 from Stakeholders and check for opposing/inconsistent comments, then send to MWH by the posted due date.

5. Next Steps for Phase I Technical Memo #2

-Outline will be developed in line with EPA guidance and will largely mirror the Site-wide FS.

Lisa: *Will that be an annotated outline?*

Stacey: *No not at this point. We can work to provide additional details if we have them, but many sections are pending the RMS.*

ACTION 2-2: MWH to send an outline for Tech Memo #2 to the team prior to the next meeting for review and discussion.

6. RMS: General Discussion

Dania: *Wanted to mention that it was difficult to completely comprehend presentation of the RMS and need a pictorial representation.*

Russ: *We have discussed and are working on including a map.*

Christina: *The spatial weighting would also be helpful presented in a map. Need an example or more information on the spatial weighting.*

Christina: *How does MWH envision incorporating into the FS?*

Stacey: *Sets the stage for media of concern and areas of concern.*

Russ: *Either an appendix or perhaps a chapter or condensed version as a section with supporting appendix.*

Stacey: *It will most likely be an appendix with salient points brought forward in the text sections; similar to the Site-wide FS.*

Christina: *It is typically not an appendix but was done this way for the Site-wide because the HHRA was pending.*

Stacey: *We should remain flexible on how we incorporate the RMS into the FS.*

Gary: The other reason the RMS was included that way in the Site-wide was due to the complexities of the receptors from the different OUs and presenting how to provide protection to the different receptors and different locations. (note - paraphrased)

Christina: *RMS will be coming to the EPA on February 22nd. Please also add this as a topic of discussion for the meeting in Denver.*

ACTION 2-3: MWH to include the following topics for the upcoming meeting in Denver:

- Questions/Comments on Technical Memo #1
- RMS
- Data gaps

7. Related Topics

Building Materials – Delivery on or before February 22, 2016

Phase I/II Boundary – Included in the RMS – Delivery on February 22, 2016

8. General Discussion – Data Gaps

Christina: *The data gaps discussed in January, we left it at needing to wait until the RMS gets flushed out. My concern is that I don't want us to get bottlenecked on field work. What is the plan for this?*

Bill: *We have a meeting planned to discuss this on February 23rd.*

ACTION ITEMS

Action Items from Previous Meeting(s)	Responsible Party	Due Date	Status
ACTION 1-1: MWH to provide Technical Memo #1 to FS Stakeholders by COB on the posted due date. At the next meeting (Jan-28) the Memo will already be in internal review, so review and feedback of the draft tables sent Monday evening is requested soon (See Action 4 below).	MWH	Complete	CLOSED
ACTION 1-2: MWH to set up a RMS meeting including this meeting's attendees and Deb McKean to obtain concurrence on the scope and direction of the RMS.	MWH	Complete	CLOSED
ACTION 1-3: EPA to provide concurrence that mine waste PRAO should not be included in Phase I and thus not included in Memo #1.	EPA	Jan-15	Open
ACTION 1-4: Team to provide small/detailed comments back on Tables 4-1 and 4-2 to MWH by COB via email.	FS Stakeholders	Complete	CLOSED: Comments received on 1/22/16; responses provided in Tech Memo #1 submittal

Action Items from Meeting #2	Responsible Party	Due Date
ACTION 2-1: Stakeholders to provide comments to Christina in the Excel table format provided for review. Christina to review comments on Technical Memorandum #1 from Stakeholders and check for opposing/inconsistent comments, then send to MWH by the posted due date.	Stakeholders	Mar-7
ACTION 2-2: MWH to send an outline for Tech Memo #2 to the team prior to the next meeting for review and discussion.	MWH	Feb-23
ACTION 2-3: MWH to include the following topics for the upcoming meeting in Denver: <ul style="list-style-type: none"> -Questions/Comments on Technical Memo #1 -RMS -Data gaps 	MWH	Mar-3

MEETING 3 MINUTES

Meeting 3: Feasibility Study Collaboration Bi-weekly Call Operable Unit 3 Study Area, Libby Asbestos Superfund Site

February 25, 2016 @ 9 am MT

Call In: 1-855-549-6718; Conference ID: 8142684

Company	Contact	Present
EPA	Christina Progross	Yes
EPA	Dania Zinner	No
MDEQ	Lisa DeWitt	No
MDEQ	Tom Stoops	Yes
USACE	Teresa Reinig	No
W.R. GRACE	Bob Marriam	Yes
W.R. GRACE	Bob Medler	Yes
W.R. GRACE	Tony Penfold	Yes
USFS	Bob Wintergerst	Yes
CDM Smith	Gary Hazen	Yes
CDM Smith	Scott Felton	No
Integral Consulting Inc.	Patrick Gwinn	No
Integral Consulting Inc.	Russ Keenan	No
MWH Americas, Inc.	Bill Pickens	Yes
MWH Americas, Inc.	Stacey Arens	Yes
MWH Americas, Inc.	Natalie Zeman	Yes
MWH Americas, Inc.	Tony Magliocchino	Yes

Format:

Main Discussion topics – **Bold and Underlined**

Subtopics - **Bold**

Dialogue – *Italicized*

Conclusions/Decisions – **Highlighted**

Action Items – **BOLD, CAPITALIZED** meeting number it was identified in – number for order it was identified during meeting. Cumulative action items (i.e., open or recently completed items from previous meetings and all items from active meeting) are summarized in tables on the last page of notes.

1. Schedule:

Technical Memo #1 sent to stakeholders Feb 5, 2016

RMS was submitted on Feb 22, 2016 along with Building Materials Memorandum

Deliverables were received by all parties.

2. Comments and Questions Regarding Technical Memo #1

Vacuum Extraction

Christina requested additional information on why vacuum extraction of ash was not retained.

Bob W: *Vacuum extraction is not used in the forest for containment of ash after a fire, and is not used on a scale we are talking about.*

Stacey: *When we spoke to our forest experts, they said it was not an applicable option for forest fire ash. We didn't see it as applicable since ash from a forest fire is spread over three dimensional objects as well as the forest floor.*

Retaining vacuum extraction of duff was also discussed even though duff is an important component of the ecosystem. Christina brought up the need to do more research on the feasibility of using vacuum extraction and provided an example of a site (Fukushima Daiichi, Japan) where vacuum extraction was considered for removal of forest litter.

The team agrees that we do not want to lose a tool that may be potentially useful in select areas. MWH will work with Wildland Fire to re-evaluate the use of vacuum extraction of forest fire ash as a removal technique. Vacuum extraction of duff for limited areas also will be re-considered after Fukushima information is reviewed. [Although not discussed specifically in the meeting, MWH would like to request literature from Christina pertaining to the use of pneumatic extraction for forest litter removal at Fukushima.]

ACTION 3-1: Christina to send pneumatic extraction literature from Fukushima accident as it pertains to the cleanup of forest litter to Grace/MWH.

No Action

Christina: *Memo 1 talks about retaining No Action in select areas with LAA impacts, but we cannot retain no action in areas where there is some unacceptable risk.*

Stacey: *Send us the offending paragraph and comment and we will make sure we are on the same page.*

[Falls under **ACTION 2-1**, see summary table]

Meaning of Impacted Media

Christina: *EPA and Grace differ on the meaning of impacted media. Unacceptable risk has not been decided and we need to address.*

Stacey: *This should be a topic we talk about on the March 3rd meeting. We don't want to focus efforts on cleanup for areas without unacceptable risk.*

Christina: *The risk of migration needs to be considered. There could be areas that may become impacted in the future. Looking at RMS provided by Grace, the footprint is relatively small as compared to EPA's area because our definition of "impacted" is different.*

Team discussion leads to the conclusion that the area defined as impacted and what defines media as being impacted needs to be a topic at the meeting on March 3rd.

ACTION 3-2: Come to agreement on the definition of impacted media and the areal extent impacted.

Biochar

Bob W: *Why was biochar selected for part of the overall remedy? Here in my role dealing with metal mines, it is being promoted for use as an absorbent. It seems that it comes at a higher expense than other options.*

Natalie: *Biochar was a favorable cover because it helps to retain soil moisture such that there is no need for watering as compared to a vegetative cover for example.*

Bob W: *Mulch and seed would provide the same benefit.*

Natalie: *In the first iteration, biochar cover was screened out as it was deemed duplicative with mulch and seed, but that was changed in this draft based on the comment to retain additional and similar technologies to provide flexibility in design.*

Bob W: *Ok I understand.*

Retaining Duplicative/Similar Technologies

Gary requests consideration of revising the text in the memo surrounding retaining technologies that are similar. Reasoning outside of the request from stakeholders should be explained and described.

MWH will work with Gary on rephrasing those words in Memorandum 1 to explain the intent of retaining duplicative technologies.

Stacey: *How should we handle the exclusion of the duplicative technologies in Memo 2?*

Gary: *I think the need to be screened out at the beginning of Tech Memo 2.*

MWH will screen duplicative technologies out at the beginning of Technical Memorandum 2.

ACTION 3-3: MWH to consider verbal comments and questions that were discussed regarding Memo #1 (pneumatic extraction/removal, ecological screening criteria, etc.) and begin revising accordingly with comprehensive revisions and response to comments coming after the receipt of written comments.

Ecological Impact as Screening Criteria

Christina brings up a concern with putting too much weight on the ecological impact of some of the technologies like removal of duff for example. She stresses the importance of coming up with an alternative that balances a reduction in human health risk while minimizing impacts to the ecosystem, but not letting a little harm to the ecosystem prevent us from using a potentially useful technology.

Bob W: *We want to avoid doing a lot at once, like removing every tree at one time. If we deal with risks to human health in steps where remediation of the area progresses over time, the ecosystem will come back and re-establish itself.*

Christina: *Yes and we need to avoid wanting to be too conservative and not touch the forest, when it is used currently as a resource.*

Bob W: *Managing fuels in a forest to protect from a fire by removal activities leads to a decrease in the overall harm to the ecosystem.*

Gary: *The Forest Management Plan can be used and referenced where it is appropriate in discussions about disturbing the ecosystem.*

The Forest Management Plan will be reviewed by MWH and used with respect to evaluations of technologies impact on the ecosystem and care will be taken to not screen out technologies that could be performed in a stepwise fashion that could limit the impacts to the ecosystem.

Guidance on Screening

Gary: *There is some discussion of lack of availability of technologies in the first step (Table 4-1). When I look at the guidance I think it outlines to do this in the second screen step in Table 4-2. In the end, the turn out will be the same so it may not matter, but is something I noticed.*

2. Questions Regarding Building Materials Memorandum

Christina: *[The memo] appears [to say that] there is not going to be a need to address materials in uninhabited buildings but regardless of use, we need to still address that concern even if they aren't inhabited because eventually they will fall down or need to be addressed by someone.*

Bill: *One building that falls into the uninhabited category is the storage building near the Mill Pond. The only things stored there were scrap lumber and there is no concern for LAA.*

Christina: *If there is no need for cleanup then that is ok and should be stated, but using the criteria of being uninhabited needs to be taken out.*

Bill: *There were 4 locations where we found buildings. One near the Mill Pond, a residence, restroom in a campground near Lake Kookanusa, and [buildings] bunkhouses that are part of the forest service. The memo assumes the bunkhouses are part of OU4.*

Christina: *I know we conducted a cleanup there, but I don't think anything was done at the bunkhouse. We have been defining what is retained in OU4 and OU3 from a practical implementable standpoint – there are some properties on the edge of OU3 that may fall into a gray zone – the idea of land use what is OU3/OU4 based on land use rather than location of the property. Anything residential would remain under OU4, if there are homes with large tracts of land and only live on a small area, the area where they are living and using (yard, shed, house) would be considered OU4, but the back 40 for example would be considered OU3. This gets tied into the bigger boundary question and the same thing applies to the Kootenai River. What area is OU3 because of the Kootenai or what area is OU4 because it is a property along the Kootenai. These questions are something we need an answer on moving forward. It will be helpful and will allow us to understand the extent of these questions when we identify the boundary. We are hoping to make headway before the meeting.*

Bill: *That will be good because it is also related to the Focus Area and RMS.*

ACTION 3-4: Stakeholders to provide comments back on the Building Materials Memo and actions taken near the USFS Ranger office.

3. Consensus on Phase I Technical Memo #2 Outline

Stacey: *We mimicked the Site Wide FS. Were there lessons learned based on how that went, changes you wish you would've done that we could apply to ours. Any feedback you have would be great. If everyone can review and we can get it approved by the next meeting that would be great.*

Christina: *I've spoken briefly with Gary about the outline. It appears to follow our outline on the site wide, so the first cut seems reasonable but I'll need to look at further.*

Gary: *What will be key is how you organize media in these alternatives, but can't answer that until later anyhow.*

Stacey: *What stymies us is the finalization of the RMS. I see a nice working meeting to brainstorm the alternatives because we don't want to go back to rework. We need input from all on the alternatives and concurrence after the RMS is finalized. The tables showing the alternatives would be similar to those presented in the sitewide FS, the 5-1 tables are in a holding pattern until we know areas and media of concern.*

ACTION 3-5: Stakeholders to provide comments/concurrence on the outline MWH sent out for Memo #2.

4. Upcoming Meetings

Stacey: *The focus and emphasis needs to be on the RMS in the upcoming weeks and we may not need the FS meeting. I can't see an opportunity to get any new Memo 2 materials out to the team before the next meeting.*

Christina: *I am in favor of not having meetings when there is not much to discuss. We can see if something falls out during the March 3rd meeting that we might want to use that time for.*

Bill: *We should consider the same thing for the monthly call next Tuesday. Do we want to go ahead and cancel that as well?*

Christina: *Yes, don't see the need.*

MWH sent the agenda for the March 3rd meeting out to the team.

Christina: *We have reviewed and will be sending a revised agenda.*

ACTION 3-6: Cancel the upcoming monthly conference meeting for Tuesday.

Meeting 2 Minutes

Stacey: *We have sent out the draft meeting minutes from the previous meeting. Please look over to make sure we captured everything and to check if you have any outstanding action items.*

Christina: *I have reviewed and have no comments.*

ACTION ITEMS

Action Items from Previous Meeting(s)	Responsible Party	Due Date	Status
ACTION 1-3: Provide concurrence that mine waste PRAO should not be included in Phase I and thus not included in Memo #1.	EPA	Jan-15	Open
ACTION 2-1: Provide comments to Christina in the Excel table format provided for review. Christina to review comments on Technical Memorandum #1 from Stakeholders and check for opposing/inconsistent comments, then send to MWH.	Stakeholders	Complete	CLOSED Comments Received on Mar-7
ACTION 2-2: Send an outline for Tech Memo #2 to the team prior to the next meeting for review and discussion.	MWH	Complete	CLOSED
ACTION 2-3: Include the following topics for the upcoming meeting in Denver: -Questions/Comments on Technical Memo #1 -RMS -Data gaps	MWH	Mar-3	CLOSED Meeting Complete, EPA comments pending.

Action Items from Meeting 3	Responsible Party	Due Date	Status
ACTION 3-1: Send pneumatic extraction literature from Fukushima accident as it pertains to the cleanup of forest litter to Grace/MWH.	EPA	Mar-10	Open
ACTION 3-2: Come to agreement on the definition of impacted media and the areal extent impacted.	All Parties	TBD	Open
ACTION 3-3: Consider verbal comments and questions that were discussed regarding Memo #1 (pneumatic extraction/removal, ecological screening criteria, etc.) and begin revising accordingly with comprehensive revisions and response to comments coming after the receipt of written comments.	MWH	TBD	CLOSED Written comments received.
ACTION 3-4: Provide comments back on the Building Materials Memo and actions taken near the USFS Ranger office.	Stakeholders	Mar-24	Open
ACTION 3-5: Provide comments/concurrence on the outline MWH sent out for Memo #2.	Stakeholders	Mar-10	Open
ACTION 3-6: Cancel the upcoming monthly conference meeting for Tuesday.	MWH	Complete	CLOSED

MEETING 4 MINUTES

Meeting 4: Feasibility Study Collaboration Bi-weekly Call **Operable Unit 3 Study Area, Libby Asbestos Superfund Site**

March 10, 2016 @ 9 am MT

Call In: 1-855-549-6718; Conference ID: 8142684

Company	Contact	Present
EPA	Christina Progress	Yes
EPA	Dania Zinner	No
MDEQ	Lisa DeWitt	Yes
USACE	Teresa Reinig	No
W.R. GRACE	Bob Marriam	Yes
W.R. GRACE	Bob Medler	Yes
W.R. GRACE	Tony Penfold	Yes
USFS	Bob Wintergerst	Yes
CDM Smith	Gary Hazen	Yes
CDM Smith	Scott Felton	Yes
Integral Consulting Inc.	Patrick Gwinn	No
Integral Consulting Inc.	Russ Keenan	Yes
MWH Americas, Inc.	Bill Pickens	Yes
MWH Americas, Inc.	Stacey Arens	Yes
MWH Americas, Inc.	Natalie Zeman	Yes
MWH Americas, Inc.	Tony Magliocchino	Yes

Format:

Main Discussion topics – **Bold and Underlined**

Subtopics - **Bold**

Dialogue – *Italicized*

Conclusions/Decisions – **Highlighted**

Action Items – **BOLD, CAPITALIZED** meeting number it was identified in – number for order it was identified during meeting. Cumulative action items (i.e., open or recently completed items from previous meetings and all items from active meeting) are summarized in tables on the last page of notes.

1. Schedule:

FS Schedule

FS Memo #1 comments from Stakeholders were received on March 7th. Based on a 60 day response period in the SOW, the Final Memo #1 will be submitted on or before May 6, 2016.

Stacey: *We are on target and don't see any issues meeting the deadline.*

Kriging Methodology Information

Scott: *We are putting it together as we speak and our goal is to have it out tomorrow afternoon or at the latest Monday.* [Friday, March 11 or Monday, March 14]

ACTION 4-1: EPA/CDM Smith to provide kriging methodology information to Grace by Friday, March 11 or Monday, March 14.

Comments on Grace Risk Management Strategy (RMS)

Stacey: *On the third [of March] I think we talked about having comments back in about a week or two. Does that sound right?*

Christina: *My calendar says to get it to MWH on the 21st, Lisa and Bob does that work for you?*

Lisa: *Yes*

Bob: *Yes*

Christina: *It might be helpful to have a couple extra days for EPA to review all stakeholder comments to remove any conflicting comments.*

Stacey: *Yes, that is very helpful to us. You'll be gone that week for Libby week, will that work for you?*

Christina: *Right, can we push back to the next week to say the 30th?*

Team agrees that stakeholders will deliver comments on the Grace RMS by the 30th.

Stacey: *We will likely need to have a few meetings after the 30th to come to an agreement, hoping to have some time in April, so mentally plan for meetings in the first couple weeks of April.*

ACTION 4-2: Christina to provide comments to MWH from stakeholders on the RMS by the 30th. Comments will be on general approach and not line by line detailed comments and will not result in a trigger of FS Tech Memo #2 deadlines. (See discussion under next topic below)

OU3 Boundary, PRAOs, RMS Letter

Christina: *During the meeting on Thursday [March 3rd] we talked about EPA providing a preliminary OU3 boundary with descriptions of PRAOs for Phase I and Phase II, and that MWH would write up some language of Phase I and Phase II that we could add into that letter and memo.*

Stacey: *Yes, I have that on my plate to develop those descriptions.*

ACTION 4-3: Stacey to provide descriptions of Phase I and Phase II to EPA for incorporation into the OU3 boundary letter.

Christina: *Was the plan to respond to the Grace RMS and then provide our RMS and the OU3 boundary letter?*

Stacey: *What I'd like is to get comments on the RMS so we understand where you're coming from. What you liked/didn't like, issues with the RMS.*

Christina: *I'm wondering if we planned on delivering these together. Lisa and Bob what do you remember? (regarding schedule for delivery of OU3 boundary letter/EPA RMS/ and comments to Grace RMS)*

Lisa: *I recall the discussion about better descriptions of Phase I and Phase II, where the boundary is and the need to feed the RMS, but I don't recall that it would be combined with the RMS comments.*

Bob: *I don't remember anything different than what Lisa said.*

Lisa: *If we combined all of those would they go out on the 30th?*

Christina: *Well, that is the issue, I don't think we can do that by the 30th. I want to think this through more. We need the RMS to support why we have the boundary that we do – one way we could work it is to provide high level RMS comments for example not detailed line by line and instead provide comments on the general approach.*

Tony P: *One thing to be cognizant of is that comments trigger timeframes for Tech Memo 2 for us.*

Christina: *Right, I think we'd send some general comments, then the letter would trigger the deadline.*

Lisa: *I agree that we could send those preliminary comments without triggering the deadline.*

Stacey: *General comments on the RMS would be helpful to get prior to the letter. Every piece we get and the more discussions we have the better off we will be and the more progress we can make.*

Christina: *Ok, we will plan to provide early preliminary comments [on the Grace RMS], then a formal letter to follow that includes the agencies position. At this time I do not have a good sense on how long it will take for the letter.*

EPA will provide general comments on the Grace RMS to the team by the 30th, but these comments will not trigger timeframes for Tech Memo 2. A letter/memo from EPA will follow that will provide OU3 boundary and PRAO information as well as the agencies' position on the RMS.

ACTION 4-4: Christina to send a memorandum to Grace providing the agencies' position on the OU3 boundary, the PRAOs/media types, and the RMS. This memo letter will trigger the Memo #2 schedule. Christina will provide a schedule for this memo letter.

Comments on RI Sections 4, 5, 6 and 8

Stacey: *When will these comments be headed back our way?*

Christina: *We will provide by the 18th is what I have on my schedule, so we are looking to have agency comments by tomorrow.*

Bob W: *Yes, it is on my schedule and I have been working on it the past couple of days.*

Lisa: *I am working on it as well and will have it to you if not Friday, by Monday morning.*

2. Phase I Technical Memo #2

Stacey: *Any comments to the Tech Memo 2 Outline?*

Christina: *I have not had a chance to look at it closely but I did not notice any issue.*

Gary: *I looked at them previously and seems fine, the devil is in the details – how assemble alternatives – as it stands it looks ok.*

Bob Marriam: *It looks ok.*

Stacey: *We will proceed with what we have and will progress as we understand the boundary.*

3. Comments from Stakeholders for Memo #1

In-situ mixing

Stacey: *What is the vision and where do we think it would be applicable? I would like some feedback on this from the group.*

Bob W: *It is an option that is potentially feasible and although I understand it can't be applied all over the place, in the overall approach it is a valid methodology especially if combined with other vegetation management activities. For example it provides the opportunity to get the duff deeper in the soil prior to following up with say a vegetative cover. It moves the duff down into the soil base.*

Stacey: *Well then we would need to identify areas where underlying materials are clean. The other concern is how that would affect the trees. How deep would you think is appropriate for in-situ mixing?*

Bob W: *Part of the study I've been working on is trying to show what the issue is with regeneration of trees, or new trees coming in and not having asbestos in the bark. With the new trees having no asbestos in the bark, I think we would be in good shape. If we till duff into the soil it may be less likely to impact new growth.*

Stacey: *Was there any mixing at East Tub Gulch?*

Bob W: *No, there has been no activity of that nature.*

Stacey: *I am trying to envision the type of equipment that will be used.*

Bob W: *I'm unsure of the exact equipment, but just something that would get the material off the surface and into the subsurface.*

Stacey: *What depth would you think, 6 inches, 1 foot?*

Bob W: *Not sure of that, but there is agricultural equipment and construction equipment we could look into.*

Stacey: *An important point to understand is where we could implement this – we need to identify.*

Bob W: *It would occur over a phased period, not likely to occur all in one year. If we deal with timber at the same time, for example if we take out a tree, it takes out an obstacle, so the areas where it is implementable may become available over time.*

Pneumatic Removal

Stacey: *Christina, you mentioned you had some information on this?*

Christina: *Yes, I have some cited articles that have it identified as a technology. I haven't read them thoroughly so I'm unsure if it was actually implemented. I've been talking to counterparts at EPA who worked with the Fukushima folks. They did a pilot study there for forest litter but from what I know it was done in a pretty small area. I think Deb had these conversations so I'd have to follow up with her to be sure, but I believe it was decided that it was not viable for a large area, mainly because of cost issues.*

Stacey: *What is the position of the group on pneumatic removal given the pilot at Fukushima?*

Christina: *I guess I would leave it up to you. You should figure out if it needs to be screened out later in the process, due to cost for example.*

Stacey: *Ok, we will keep an open mind, review the material you send, then decide [if] it would get screened out.*

Christina will send the information she has gathered on pneumatic extraction and MWH will review in order to come to a decision on the best approach for the screening of the removal technology. (See **ACTION ITEM 3-1** from previous meeting listed in the table on the last page.)

Reevaluation of Approach to Covers

Stacey: *We want to provide a more clear approach to covers that we have proposed [in the tech memo] and will look at that in light of your comments. We've had internal discussions about how to improve and think it will hopefully clear up issues on covers and vegetative covers.*

Christina: *Considering the scenario if trees will be thinned or cut down – how will you look at that in the FS as far as sequencing – logging / thinning/ clearing then following with another technology.*

Stacey: *This will be in development in remedial alternatives – forest management could be combined with other technologies. The development of remedial alternatives is where we focus next and will need to be thoughtful about how we combine to have a comprehensive alternative. The phasing and sequencing of technologies will happen then.*

Gary: *One observation about the covers – my thought is you could approach it based on what the goal or objective of the barrier is rather than the exact type of material used.*

Christina: *Right, what it specifically looks like could be dealt with during remedial design.*

Stacey: *Yeah, that is a very similar approach as what we've discussed doing internally.*

4. Status of Old Business (Review of Action Items identified during previous meetings)

ACTION 1-3: Media types to be included in the Phase 1 and Phase 2 FSs will be provided in the next deliverable to Grace. (**ACTION 4-3**) – Status: Closed. New **ACTION 4-3** will cover this topic.

ACTION 3-2: The agreement on definition of impacted media is being worked through via the RMS. **Retain action item.**

ACTION 3-4: The building materials memo is on hold. Need feedback from EPA and boundary definition.

Christina: *I have on my list to figure out what we know about the four buildings near the USFS Ranger Office and whether they've been investigated.*

Retain action item.

5. Next Steps

- Consensus on RMS approach and agreement on boundary
- Assembly of Alternatives

6. Upcoming Meetings

April 7th is the next meeting because the next bi-weekly meeting is cancelled for Libby week.

Note to team: Stacey will be out of the country starting April 18th. Bill, Tony M. and Natalie will move things forward in her absence.

ACTION ITEMS

Action Items from Previous Meeting(s)	Responsible Party	Due Date	Status
ACTION 1-3: Provide concurrence that mine waste PRAO should not be included in Phase I and thus not included in Memo #1.	EPA	Deferred to new action identified in Meeting 4	CLOSED Defer to new ACTION 4-4
ACTION 3-1: Send pneumatic extraction literature from Fukushima accident as it pertains to the cleanup of forest litter to Grace/MWH.	EPA	Mar-21	Open
ACTION 3-2: Come to agreement on the definition of impacted media and the areal extent impacted.	All Parties	TBD	Open
ACTION 3-4: Provide comments back on the Building Materials Memo and actions taken near the USFS Ranger office.	Stakeholders	Mar-24	Open
ACTION 3-5: Provide comments/concurrence on the outline MWH sent out for Memo #2.	Stakeholders	Complete	CLOSED Verbal concurrence was provided

Action Items from Meeting 4	Responsible Party	Due Date	Status
ACTION 4-1: EPA/CDM Smith to provide kriging methodology information to Grace.	EPA/CDM	Mar-14	Open
ACTION 4-2: Christina to provide comments to MWH from stakeholders on the RMS by the 30 th . Comments will be on general approach and will not result in a trigger of Phase 1 FS Memo #2 schedule.	EPA	Mar-30	Open
ACTION 4-3: MWH to provide descriptions of Phase I and Phase II to EPA.	MWH	Apr-8	Open
ACTION 4-4: Send OU3 boundary, PRAO, RMS Memo letter to Grace providing the agencies' position. This Memo letter will trigger the Phase 1 FS Memo #2 schedule.	EPA	TBD	Open

MEETING 5 MINUTES

**Meeting 5: Feasibility Study Collaboration Bi-weekly Call
Operable Unit 3 Study Area, Libby Asbestos Superfund Site**

April 7, 2016 @ 9 am MT

Call In: 1-855-549-6718; Conference ID: 8142684

Company	Contact	Present
EPA	Christina Progress	Yes
EPA	Dania Zinner	Yes
MDEQ	Lisa DeWitt	Yes
USACE	Mark Meacham	Yes
W.R. GRACE	Bob Marriam	Yes
W.R. GRACE	Bob Medler	No
W.R. GRACE	Tony Penfold	Yes
USFS	Pamela Baltz	Yes
CDM Smith	Gary Hazen	Yes
CDM Smith	Scott Felton	Yes
Integral Consulting Inc.	Patrick Gwinn	No
Integral Consulting Inc.	Russ Keenan	Yes
MWH Americas, Inc.	Bill Pickens	Yes
MWH Americas, Inc.	Stacey Arens	Yes
MWH Americas, Inc.	Natalie Zeman	Yes
MWH Americas, Inc.	Tony Magliocchino	Yes

Format:Main Discussion topics – **Bold and Underlined**Subtopics - **Bold**Dialogue – *Italicized*Conclusions/Decisions – **Highlighted**

Action Items – **BOLD, CAPITALIZED** meeting number it was identified in – number for order it was identified during meeting. Cumulative action items (i.e., open or recently completed items from previous meetings and all items from active meeting) are summarized in tables on the last page of notes.

1. Introductions**2. Review of Action Items from Previous Meetings**

ACTION 3-1: EPA to send pneumatic extraction literature from Fukushima accident as it pertains to the cleanup of forest litter to Grace/MWH.

Christina: *Yes I have some information. All I have is a PowerPoint but I will get it to you soon.*

Keep action item open – Christina to complete.

ACTION 3-2: All parties to come to agreement on the definition of impacted media and the areal extent impacted.

Stacey: *This item is ongoing as we work through the RMS.*

Keep action item open – Will be resolved through the RMS.

ACTION 3-4: Stakeholders to provide comments back on the Building Materials Memo and actions taken near the USFS Ranger office.

Stacey: *We've received verbal comments but we wanted to know if there were any further investigations done for vermiculite material on those buildings near the USFS Rangers office.*

Christina: *I apologize for not getting this to you sooner. I will look at the response manager database and locate that information.*

Keep action item open – Christina to look at the available data and provide an update to the team.

ACTION 4-1: EPA/CDM Smith to provide kriging methodology information to Grace on March 11, 2016 or March 14, 2016.

Christina: *Scott can you remind me what we decided on how we were going to provide to Grace?*

Scott: *Sure, we decided it will be provided in the [OU3 boundary, PRAO, RMS] letter*

Christina: *Ok, so we will provide the kriging in the [OU3 boundary, PRAO, RMS] letter memo explaining how we came to that and then separately send comments on the RMS.*

Stacey: *In the previous meeting we had discussed getting the kriging information earlier. Is there a way we can still get that ahead of the [OU3 boundary, PRAO, RMS] letter memo?*

Christina: *In the meeting in Denver, we realized the concern with the boundary and that Grace wanted to see the EPA write up of the boundary approach. The intent is to provide a letter with a map, and that letter will ultimately also include the RMS approach with kriging information. Also for providing comments on the RMS, we've discussed giving Grace 2 weeks to respond to the comments and then after that 2 weeks, the Memo 2 schedule would be triggered.*

Bob Marriam: *Can we go back to the previous item for a minute? The definition of impacted media, when are we going to get that done?*

Christina: *I believe that will be covered in the RMS*

Bob Marriam: *But I thought it was just a definition?*

Stacey: *Memo 1 had some definitions on media types that will be included or are of concern. I think where we aren't seeing the same picture are the risks for bark and the [HQ of] 0.5 spatial weighting and when we got the map on the 3rd the areal extent was larger than we thought.*

Christina: *This line item will be included in the boundary approach. I agree that our approaches are different and understand that it is difficult for MWH and Grace to have discussions regarding the boundary without having our approach or understanding our approach.*

Bill: *To get the kriging data in advance of the other information, is that still a possibility?*

Christina: *I'm unsure, and would need to discuss with Scott. I will talk with Scott and get back to you on that.*

Stacey: *Yeah, it would be useful to have that ahead of the [OU3 boundary, PRAO, RMS] letter. When are you anticipating having that to us?*

Christina: *There have been many people out of town so it's been difficult to make progress. Our goal is to have it out the week of the 18th.*

Christina to talk with Scott to see if it will be feasible to provide Grace and MWH the kriging methodology used prior to the OU3 boundary, PRAO, RMS Comment Letter that will be submitted the week of the 18th.

ACTION 4-2: EPA to provide “high-level” general comments to MWH from stakeholders on the RMS. Comments will be on general approach and will not result in a trigger of Phase 1 FS Memo #2 schedule.

Christina: *These [general high level comments] will not be provided separately. They will be provided at the same time as the [OU3 boundary, PRAO, RMS] letter.*

ACTION 4-3: MWH to provide descriptions of Phase I and Phase II to EPA.

Stacey: *These are going through internal review now, so they should be forthcoming. The goal would be to get it out in the next week to two weeks.*

ACTION 4-4: EPA to send OU3 boundary, PRAO, RMS Comment letter to Grace providing the agencies’ position.

Discussed previously under ACTION 4-1, and will be submitted the week of April 18th.

3. FS Schedule – Update Phase I FS Technical Memo #1 status/issues. (FS Memo #1 comments from Stakeholders were received on March 7th. Based on a 60 day response period in the SOW, the Final Technical Memo #1 will be submitted on or before May 6, 2016.)

Stacey: *Is this technical memorandum being submitted as a Final? How should I identify it?*

Christina: *I think we should consider it draft final and if there are no more comments I can send an email/letter and we can consider it final.*

Stacey: *There may be things that come along in subsequent memos that require revisions to the previous memos so I wasn’t sure.*

Christina: *How will the tech memos be included in the FS? Will they be an attachment or referenced, or included in the body of the document?*

Stacey: *I was thinking we would use the tech memos and marry them together, so they would be used as the body of the text and not necessarily an attachment.*

Christina: *Yeah I think that makes the most sense. I prefer that approach.*

Stacey: *With this approach, there may be some language that will need to be modified slightly.*

Christina: *In that case, there is no need to finalize and we can keep it as a work in progress. Does that work?*

Stacey: *Yes.*

Lisa: *I think that is reasonable.*

Dania: *Sounds good to me.*

Stacey: *Bob and Tony are you ok with that approach? Leaving it as a draft final that way we can modify later.*

Tony: *That sounds good but we would probably just need to formalize that in some kind of correspondence since the schedule refers to it [technical memos] as final.*

Stacey: *Christina, after you receive the next version and you think it's acceptable you could send an email letter stating that it satisfies the requirements.*

Christina: *Sure, that works.*

Tony: *Sounds good.*

Bob Marriam: *Sounds good.*

Stacey: *Lisa, can you talk with Catherine to see when we could see the latest version of ARARs? We want to include in this next Memo 1 deliverable.*

Lisa: *Let me check and see what the status is. Could we use the old one if it isn't ready?*

Bob Marriam: *Let's get the latest one.*

Stacey: *If Catherine can pull it off that would be nice.*

Christina: *I got the impression we had worked through the issues on ARARs. Are there any more we need to discuss, or is the version Catherine provides ok?*

Stacey: *I think it should be OK, but would like to see before giving a final say. It's not really my place to decide and any issues would come out of the legal review.*

Stacey: *I think at this point we both understand the ARAR set and how it would be applied so I feel good about that.*

ACTION 5-1: Lisa to coordinate with Catherine on obtaining the most up to date ARAR version for incorporation into the Draft Final Tech Memo #1 deliverable.

4. Comment Clarification on Phase I Technical Memo #1

Forest Service Comment: Legal Controls – Governmental Controls on Table 4-1a - To make this relate to a Forest environment it should be referenced in terms of “area closures”. Please clarify what this means, how we should incorporate.

Stacey: *Pam you may need to consult with Bob [Wintergerst] on this, but we want to understand if this is a type of legal control and understand more about it so we can appropriately incorporate.*

Pam: *Sure, if I can get a copy of Tech Memo #1, I will take a look and get back to you.*

Christina: *I can send you a copy of the comments Bob provided.*

Stacey: *We want to understand the legal controls and what area controls mean to the Forest Service.*

ACTION 5-2: Christina to send Pam a copy of Memo #1 and the comments provided by Bob. Pam to review the comment from Bob Wintergerst on area closures and provide clarification on the meaning of area closures and how to appropriately incorporate into Draft Final Tech Memo #1 institutional controls.

EPA/MDEQ/Forest Service Comment – In-Situ Mixing - Retain in 4-1s. We have revised Table 4-1s to retain it for technical feasibility for limited areas, but are considering screening out in 4-2s based on effectiveness / implementability / cost.

Natalie: (paraphrased summary)

Previously in-situ mixing was not retained past 4-1, therefore, did not go through the effectiveness, implementability and cost screening and ranking. Since it's now being retained for technical implementability for limited areas in 4-1 for duff, soil and forest fire ash, it's being looked at more closely and based on the additional screening for 4-2 that we've been working on it is uncertain to me whether it makes sense to retain in-situ mixing for assembly of alternatives and I'm leaning towards not retaining based on this most recent review. So with that, I'll go ahead and share my thoughts with the group and then I'd like to get feedback and opinions on where it stands now and open it up for discussion so we can make a decision on how to move forward.

Reasons for coming up with relatively low effectiveness and implementability numbers for in-situ mixing for soil, duff, and forest fire ash included:

- Surface mixing or tilling would result in loosening of the materials and root structures that hold things together presenting a migration concern since it could potentially increase mobility and erosion. This is particularly concerning for forest fire ash, because the root structures that remain after a fire are part of what prevents larger erosion events from occurring such as mudslides.*
- Another issue is the possibility that underlying materials contain LAA at higher concentrations than surface materials and this particularly applies to duff and soil. The concern is based on the concept that underlying materials were exposed during active mining, and are thus may have higher LAA concentrations. This leads to an implementability challenge because there would be a need to characterize the vertical concentration profile prior to mixing to evaluate the risk.*
- An additional implementability concern is if we use a tilling approach, it would only be technically feasible on slopes less than 30% based on my review of tilling equipment limitations. This already limits us significantly and then there are also issues such as shallow soils and bedrock outcrops that would also present implementability challenges.*

That summarizes the main items I was thinking through during the screening evaluation that limit its viability for the site. Thoughts?

Tony Penfold: Another thing I would add is it is particularly difficult in forested areas that are heavily wooded and would be a massive problem to get around with the equipment.

Christina: For thoughts and questions on this we need to tie into the Forest Service. What comes to my mind with respect to the slope angles being too great to till is that the Forest Service has restoration folks who perform mop up tilling of soil and ash. The BAER teams specialize in restoration after a fire so it would be helpful to get their input on how they do the tilling and follow up with vegetation.

Bob Marriam: Seems to me we need an answer from the Forest Service on this.

Pam: I can work to get that information from them.

Tony Penfold: In the ABS we've done, anything with heavy equipment and disturbance of soil has resulted in stirring up a fair amount of LAA that may also feed into exposure of the workers implementing the mixing.

Bob Marriam: This is a good first shot, but we need more information from the Forest Service.

Gary: *The post-fire situation is unique. Many of the trees are removed after a fire so I think to move forward with what we have now is premature. We need more information and should see what the Forest Service provides before deciding to remove from the process.*

Christina: *It would also be helpful to see if we can get GIS layers that show areas that have >30% slope. Understanding where activities may be implementable and how much of the area would fit into those categories would be helpful. Pam and I can work to get the team information regarding BAER procedures. It may be helpful to have a conference call focusing on in-situ mixing and how it is applied from a Silva culture standpoint. Can MWH provide a map with the topography, then we can schedule a conference call once you've had a chance to look through the information provided by the BAER folks?*

Stacey: *Sure that sounds good. It would be preferable to have this information soon so it can be used for the next deliverable of Memo 1.*

Christina: *OK, we will work to get you the information soon.*

ACTION 5-3: Pam and Christina to provide information to MWH on potential usage of in-situ mixing with respect to BAER activities. After MWH reviews the material, Pam and Christina will work to coordinate a meeting with the appropriate people from the Forest Service/BAER teams to discuss any follow up questions.

ACTION 5-4: MWH to provide a topo map with slopes to aid in the discussion of in-situ mixing feasibility at OU3 with the Forest Service after receipt of BAER information.

5. Next Steps

- Consensus on RMS approach and agreement on boundary
- Assembly of Alternatives

6. Upcoming Meetings

April 21, 2016 – FS Bi-weekly Collaboration Meeting

Note to team: Stacey will be out of the country starting April 18th. Bill, Tony M. and Natalie will move things forward in her absence.

ACTION ITEMS

Action Items from Previous Meeting(s)	Responsible Party	Due Date	Status
ACTION 3-1: Send pneumatic extraction literature from Fukushima accident as it pertains to the cleanup of forest litter to Grace/MWH.	EPA	Mar-21	Open Christina to send PowerPoint
ACTION 3-2: Come to agreement on the definition of impacted media and the areal extent impacted.	All Parties	TBD	Open
ACTION 3-4: Provide comments back on the Building Materials Memo and actions taken near the USFS Ranger office.	Stakeholders	Mar-24	Open Christina to provide
ACTION 4-1: EPA/CDM Smith to provide kriging methodology information to Grace.	EPA/CDM	Mar-11	Open Christina to talk with Scott about providing ahead of the letter (ACTION 4-4)
ACTION 4-2: Christina to provide comments to MWH from stakeholders on the RMS by March 30. Comments will be on general approach and will not result in a trigger of Phase I FS Memo #2 schedule.	EPA	NA	CLOSED General comments will be provided at the same time as the Memo Letter (ACTION 4-4)
ACTION 4-3: MWH to provide descriptions of Phase I and Phase II to EPA.	MWH	Apr-29	Open Pending receipt of Action 4-4 items.
ACTION 4-4: Send OU3 boundary, PRAO, RMS Comments letter to Grace providing the agencies' position. Upon receipt, Grace will have a 2-week window for discussion. The clock starts for Memo #2 following discussion.	EPA	Week of April-18	Open

Action Items from Meeting 5	Responsible Party	Due Date	Status
ACTION 5-1: Lisa to coordinate with Catherine on obtaining the most up to date ARAR version for incorporation into the next Memo 1 deliverable.	MDEQ	Prior to May-6	Open
ACTION 5-2: Christina to send Pam a copy of Memo #1 and the comments provided by Bob. Pam to review the comment from Bob Wintergerst on area closures and provide clarification on the meaning of area closures and how to appropriately incorporate into Memo #1 institutional controls.	EPA/Forest Service	April-21	Open Memo 1 and comments sent April 11 th .
ACTION 5-3: Pam and Christina to provide information to MWH on potential usage of in-situ mixing with respect to BAER activities. After MWH reviews the material, Pam and Christina will work to coordinate a meeting with the appropriate people from the Forest Service/BAER teams to discuss any follow up questions.	Forest Service/ EPA	April-15	Open
ACTION 5-4: MWH to provide a topo map with slopes to aid in the discussion of in-situ mixing feasibility at OU3 with the Forest Service after receipt of BAER information	MWH	April-29	Open

May 6, 2016

U.S. Environmental Protection Agency, Region 8
Attn.: Christina Progross, OU3 Project Manager, Superfund Remedial Program
1595 Wynkoop Street
Denver, CO 80202

**Subject: Draft Final Identification and Screening of Technologies Technical Memorandum
Phase 1 Feasibility Study, Operable Unit 3 Study Area, Libby Asbestos Superfund Site,
Libby, Montana**

Dear Christina:

This letter transmits the ***Draft Final Identification and Screening of Technologies Technical Memorandum, Phase 1 Feasibility Study, Operable Unit 3 Study Area, Libby Asbestos Superfund Site, Libby, Montana***, which is being submitted in accordance with the *Revised Statement of Work (Revised SOW) for Remedial Investigation (RI)/Feasibility Study (FS), Libby Asbestos Site, Operable Unit 3* dated December 15, 2015.

Per the Revised SOW, the FS component of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) RI/FS process will be developed in two phases.

- Phase 1 addresses areas of OU3 adjacent to the mine site (e.g., forested areas not disturbed by mining activities and roads not used for mining access) that are not a part of Phase 2.
- Phase 2 will address the mine site, areas disturbed by mining activities (including the rock disposal area, tailings piles, the Amphitheater, rock quarries, mining access roads such as Rainy Creek Road, and previously reclaimed areas), and water bodies (e.g., the impoundment dam, Rainy Creek, Carney Creek, Fleetwood Creek, and the Kootenai River).

Additionally, per the Revised SOW, each FS will be divided into four interim memoranda to allow additional review iterations and concurrence throughout the FS process. The following four technical memoranda will be developed for each phase:

1. Identification and Screening of Technologies
2. Development and Screening of Alternatives
3. Detailed Analysis of Alternatives
4. Comparative Analysis of Alternatives

The four technical memoranda then will be compiled into a Draft FS, one for Phase 1 and a separate document for Phase 2. Therefore, the attached memorandum will be a component of the larger Phase 1 FS document.

In addition to the four technical memoranda, a Risk Management Strategy (RMS) will be developed focused on defining the media of concern and the performance criteria that will provide adequate protection of human health from exposure to Libby Amphibole Asbestos (LAA), and the extent and the boundary of the Phase 1 Area. The concurrent development of the RMS with the FS, as required in the Revised SOW based on the schedule of deliverables, limits the quantitative details that otherwise would be addressed by incorporating results of the RMS. Accordingly, the performance criteria presented in the RMS could potentially require significant changes to be made to the FS Memoranda, which will be captured in the Draft FS. Although the RMS is in development, the media types that may pertain to the Phase 1 Area have been defined as duff, forest soil, forest fire ash, and bark. The media types of concern and boundary considerations may be amended based on the RMS for Phase 1.

To limit necessary regulatory review time and reduce redundancy, the sections presented in the attached memorandum are Section 3.0, Remedial Action Objectives and Section 4.0, Identification and Screening of General Response Actions, Remedial Technologies, and Process Options. Sections 1.0 and 2.0, which include background site information (e.g., site location and description, site background, site features and physical characteristics, risk assessments summary, conceptual site models) are not included in this memorandum. These sections largely will be taken from the Final Remedial Investigation (RI) Report, the draft final version of which is currently undergoing revision and regulatory review. It is anticipated that the Final RI Report will be available prior to the Draft Phase 1 FS submittal date and will include information typically summarized in Sections 1.0 and 2.0.

This technical memorandum has been prepared in accordance with the Revised SOW and the EPA RI/FS Guidance (EPA, 1988). The memorandum is organized as follows:

- Section 3 describes the process for identifying preliminary remedial action objectives (PRAOs). This section also discusses current and anticipated future land use at the site and the process for identification of potential applicable or relevant and appropriate requirements (ARARs).
- Section 4 describes the options for general response actions (GRAs) and the screening and evaluation of different remedial technologies and process options. General response actions were developed in accordance with the FS PRAOs. Technology types and process options applicable to these general response actions were selected and screened to identify those applicable and implementable at the OU3 Phase 1 Area.
- Two sets of media-specific tables were developed in Section 4. The first set, Tables 4-1a through 4-1d, represent the first major step in the "Identification and Screening of Remedial Technologies and Process Options." Within these tables, a wide range of potentially applicable technology types and process options are developed. These options go through their first screening step here, which is technical implementability. Screening is conducted primarily by using onsite characteristics to screen out technologies and process options that cannot be effectively implemented at the site.
- The second set of tables (Tables 4-2a through 4-2d) align by media type with Tables 4-1a through 4-1d. Within these tables, the potentially applicable technology types and process options that were retained from Tables 4-1a through 4-1d are evaluated in greater detail based on effectiveness, implementability, and costs.



BUILDING A BETTER WORLD

Responses to comments provided by the EPA, Montana Department of Environmental Quality (MDEQ), and United States Forest Service (USFS) on the draft version of Technical Memorandum #1 are included as an attachment to the memorandum.

This memorandum has been developed in a highly collaborative and transparent process. Bi-weekly meetings have been, and will continue to be held, with a stakeholder group that includes EPA, MDEQ, USFS, United States Army Corps of Engineers (USACE), CDM Smith, W.R. Grace & Co.-Comm (Grace), Integral, and MWH. The final meeting minutes from the meetings held to date have been included as an attachment to the memorandum.

We appreciate your attention to this matter. If you have any questions or require further information, please contact Bill Pickens at 303-291-2142 or Stacey Arens at 801-617-3219.

Sincerely,
MWH Americas, Inc.

William E. Pickens, PG
Vice President

Stacey Arens, PE, LEED AP
Principal Engineer

Encl: *Draft Final Phase 1 Identification and Screening of Technologies Technical Memorandum, Operable Unit 3 Study Area, Libby Asbestos Superfund Site, Libby, Montana.*

Memo Attachments:

- Attachment A – Preliminary Applicable or Relevant and Appropriate Requirements (ARARs) for the OU3 Study Area
- Attachment B - Response to Comments provided by stakeholders
- Attachment C - Final Meeting Minutes Feasibility Study Collaboration Bi-Weekly Calls: January 14, 2016, February 11, 2016, February 25, 2016, March 10, 2016, and April 7, 2016

cc: Stakeholder List – attached
MWH file

Libby Asbestos Superfund Site, OU3 Study Area Stakeholders

U.S. Environmental Protection Agency (All electronic copies except EPA Info Center):

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